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Article abstract

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Supporting Students with Diverse Learning Needs Using Universal Design for Learning in Online Learning: Voice of the Students

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Abstract

During the COVID-19 pandemic, online learning became the predominant mode of learning for 33 to 54% of students in Canada's three largest school boards. As inclusive practices continue to grow and online learning is now part of the Ontario curriculum, educators need guidance on how to support K-12 students with diverse learning needs in online and inclusive classrooms. This case study attends to the voice of elementary and high-school students, with and without disabilities who shared their experiences of online learning during the pandemic. It explored the impacts of integrating multiple methods of instruction, assessment, and technology to accommodate diverse learning needs. Results indicated that limited opportunity for connections and lack of structure and guidance were key factors that impacted the students' motivation and ability to learn in the online environment, and age was a determining factor in technology use preferences.

Introduction

The abrupt switch to online learning within the province of Ontario, due to the COVID-19 pandemic significantly impacted approaches to learning for students with disabilities (MacKay et al., 2021). Gallagher-Mackay et al. (2021) reported that the first in-person school closures in Ontario during March-June 2020 led to increased absenteeism, and disproportionately disadvantaged students with disabilities across the province.

In the fall of 2020, because of the ongoing concerns of the pandemic, families were provided with the option of continuing to learn online, or return to the physical classroom (Ford, 2020). Despite the Ontario Ministry of Education's (OME) (2020b) promise of safety

adaptations in the classrooms, the demand for online learning surged among the three largest school boards in Ontario: Toronto (TDSB, 2020), Peel (Thompson, 2020), and York Region (YRDSB, 2020) school boards, with registrations ranging from 33% to 54% of the student population. Within the TDSB, approximately 14,000 (17% of online learners) required special-education support (TDSB, 2020). Therefore, online teachers needed to be prepared to offer the same level of support for a diverse student population online, as those that were offered in person. However, at the outset, teachers were not readily equipped with the skills and resources to develop inclusive teaching techniques online (Charlesworth, 2020).

Noting the demand for online learning, especially for students with diverse learning needs, this exploratory case study was conducted in order to give an account of the students' experiences during this significant moment in time, and to contribute to the growing body of evidence that examines approaches of inclusive[1] online learning practices, and, by extension the potential for these innovations to support future in-person learning post-pandemic. Findings may also benefit future teaching practices in online inclusive environments since online learning options continue for K-12 students in Ontario after COVID-19, and high school students in Ontario are now required to complete two online courses prior to graduation (People for Education, 2022).

We began our examination of students' experiences with a review of the literature related to the critical questions which emerged about learning in inclusive online environments. The review included the question of balancing varying types of online learning environments, then shifted to outlining what was known about online learning experiences for children with disabilities. We adopted the Self-Determination Theory (SDT) as the theoretical frame for our analysis, to examine the impact of student engagement and motivation with diverse learners.

Literature Review

Prior to the pandemic, online learning literature was dominated by post-secondary education, which may or may not offer insights into learning with younger, K-12 students (Bower et al., 2015; Do, 2018). Since the pandemic, COVID-19 online K-12 teaching literature has emerged, but very few authors have attempted to examine online inclusive education to support students with diverse learning needs (Dahlstrom-Haki et al., 2020). Therefore, in grounding our research, we brought together what was known about the blend of varying modes of online learning, student engagement, and student learning diversity. We start with an inquiry into student engagement through the lens of the Self-Determination Theory (SDT).

Self-Determination Theory relationship to student engagement

Student engagement encompasses behavioural, cognitive, emotional, and agentic engagement; however, the specific definitions of each of these components have varied over time (Fredricks et al, 2004; Sinatra et al., 2015). Behavioural engagement was defined by Fredricks et al. (2004) as students attending and participating in class. Yet, Sinatra et al. (2015) argued that attention was also needed for students to actively participate in their learning. Emotionally engaged students, according to Fredricks et al. (2004), were those who experienced interest and

[1] According to the Canadian Research Centre on Inclusive Education (2021), inclusive education is when "All students actively participate and learn with their peers in the same classroom and adaptations and accommodations are made for all to succeed" (par. 1).

enjoyment in their learning. Moreover, Sinatra et al. (2015) also believed that emotional engagement was related to the experiences and feelings students had about interactions with teachers, peers, and learning experiences. Pekrun et al. (2002) defined cognitive engagement as a real desire to understand the content using self-directed strategies. Finally, agentic engagement, as described by Reeve (2013), was an integration of behavioural, emotional and cognitive engagement through its emphasis on behaviour, thoughts, and action. Reeve viewed agentic engagement as critical to student-centred learning, and the enhancement of motivation in autonomous-supported environments. Therefore, agentic engagement has been particularly important in online learning where students may have less direct support, and be required to use different strategies and resources than were typically used in face-to-face environments (Ellis et al, 2018).

These definitions of engagement align with various motivational theories, including Carl Rogers' humanistic theory, Carol Dweck's implicit theories of intelligence (also known as growth and fixed mindset), and Richard Ryan and Ed Deci's self-determination theory (SDT) (Dweck, 2016; Rogers, 1980; Ryan & Deci, 2020). Rogers (1980) believed that engagement and motivation occurred when students were active in their learning through the choices of what and how they learned. Dweck (2016) proposed that levels of engagement were related to an individual's mindset, where individuals with a growth mindset were more engaged than those with a fixed mindset. However, our study most closely aligned with the self-determination theory, which proposed that students were engaged and intrinsically motivated to learn through three basic psychological needs; competence, autonomy, and relatedness (Ryan & Deci, 2020).

According to SDT, competence was achieved through mastery of experiences and feedback (Deci et al., 1991; Ryan & Deci, 2020). Perceived competence could be negatively affected by students with special-education needs, if they had low self-efficacy, due to repeated academic failures and inability to master experiences (Rhew et al., 2018). Deci et al. (1992), believed that encouraging competence in students with disabilities through feedback and structure positively influenced their motivation and beliefs that they could achieve their goals. In online learning, competence could be developed with well-structured discussion forums and sound guidance throughout online activities (Chiu & Mok, 2017; Vonderwell et al. 2007).

The second need of autonomy was achieved through self-initiation and choice of one's own actions (Deci et al., 1991; Ryan & Deci, 2020). Self-Determination Theory further suggested autonomous-supportive environments offered students meaningful choices, by considering the unique characteristics, interests, needs, and challenges faced by diverse learners (Deci et al., 1991; Ryan & Deci, 2020). Many types of technological features could be used to provide students with varied ways of receiving and evaluating their understanding of online materials (Alamri et al., 2020; Hartnett, 2015).

Finally, relatedness was the feeling of belongingness satisfied by developing secure connections with others (Deci et al., 1991; Ryan & Deci, 2020). Online learning offered the opportunity to satisfy relatedness through teacher support, collaborative learning with peers, and small group discussions (Almri et al., 2020; Vonderwell et al., 2007). Chiu's (2021) study on the relationship between SDT and student engagement in online learning environments found that student engagement was impacted by all three needs of SDT, but relatedness had the strongest correlation. However, Chiu's (2021) study did not make any distinctions between typical learners and those with diverse learning needs, which was the focus of our study. Therefore, our literature review starts with an examination of student engagement in varying online environments followed by the impact on students with disabilities.

Student engagement in varying online learning environments

One of the critical factors that appeared to rise to the top of the discussions in the newly emerging K-12 online teaching literature was the influence of varying modes of online teaching on students' learning and engagement (Erümit, 2021; Herman, 2020; Hersh, 2020).

In an example from Turkey, Erümit (2021) reported an increase in student motivation associated with increasing synchronous interaction. Herman (2020) suggested that human connectedness in platforms, such as Zoom (a synchronous meeting tool using both voice and video), may contribute to improved engagement, because it more closely mirrors the classroom experience. Additionally, Hersh (2020) posits the use of small-group sessions in Zoom breakout rooms as an important learning tool to increase the student voice in online learning. Coy et al.'s (2014) pre-COVID study evidenced how educators adopted a variety of online interactive tools (audio, video, webcam, chat room, whiteboards, PowerPoint presentations, and websites) to increase engagement.

Despite the aforementioned advantages of synchronous sessions, this online format could quickly be sidelined when students' caregivers or teachers were not confident in using technology adequately, or when students had learning preferences/needs which made synchronous activities difficult (Do, 2018; Hogan & Sathy, 2020). Hence, Hogan and Sathy (2020) outlined the importance of students' access to recordings of lessons, in addition to synchronous learning. Do (2018) evidenced learning tasks established using text-based group tools, such as Google documents or slides as an effective middle ground in supporting concurrently asynchronous/synchronous learning though text-based discussions. The teachers and students in Sharpe's (2019) study on Google Classroom indicated that its combined technologies could help students 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, a balance of online learning modes may better support the unique learning needs of students with disabilities.

The impact on students with disabilities

Although the effectiveness of online learning for students with disabilities has not been fully explored (Dahlstrom-Haki et al., 2020), the challenges faced by this population must consider individuals' unique learning needs and accommodations, which, when not addressed, significantly impact their engagement and motivation to learn (Carver & Rowe, 2020; Erümit, 2021; Ferdig & Pytash, 2021; GAO, 2020; Tindle et al., 2017).

Within Ontario, individual needs of students who require special-education support are addressed through the development of an Individual Education Plan (IEP), which can be more difficult to implement online than in bricks-and-mortar settings (GAO, 2020; Tindle et al., 2017). Ferdig and Pytash (2021) also recognized inconsistencies in the way students interacted with online learning, with some students excelling, while others were deprived of engagement between teachers and students. When provided with appropriate support, students with disabilities were more engaged using technology than traditional approaches, and these students also chose to participate in online courses at higher rates than students without disabilities (Thompson et al., 2012). This demonstrated the importance for educators to continue providing high-quality online learning experiences that address the varying needs of these students.

However, supporting students with disabilities in online learning required that students and teachers were comfortable and capable with the technology used. Carver and Rowe (2020) showed that student challenges using technology during school closures required parental support, which frustrated both students and parents (Carver & Rowe, 2020). Conversely, GAO (2020) reported that technology increased student engagement in online learning environments for some students with identified social anxiety and other mental conditions.

Bjekic et al. (2014) conveyed that students may become more engaged in the use of technology when teachers considered multiple methods to represent instruction and confirm students' understanding of the material using the principles of Universal Design for Learning (UDL). This is an instructional framework that provides students with opportunities of multiple means of representation, multiple means of action and expression, and multiple means of engagement (Cast, 2018). Representation refers to the way learners perceive and understand material using different modalities that align with different learning preferences. Action and expression enable learners to express what they know in alternative ways that work best for them. Engagement impacts a student's motivation to learn by enabling them to interact with the material in a variety of ways (CAST, 2018). In addition to promoting engagement, UDL also paralleled the self-determination theory (SDT), with its emphasis on person-centred approaches to learning, which maximized student choice and voice (Edyburn, 2020; Ryan & Deci, 2017). Ismailov and Chiu's (2022) investigation of the relationship between a UDL-based online course and SDT found that the UDL principle of providing multiple means of action and expression supported autonomy, and positively shaped behavioural engagement through the variety of resources available for learning and assessment. The results of the study also supported competence and enhanced cognitive engagement through the interactive instructional strategies utilized by the teacher, which provided multiple means of representation and engagement.

The integration of UDL with online learning was especially critical in supporting the needs of students with disabilities, by accounting for both learner variability and student engagement (Basham et al., 2020). The online-learning experiences during the pandemic of students with diverse needs, and the ongoing need for online learning post pandemic, made it clear that far more research is needed in this area to support online learning for elementary and high-school students with disabilities. Therefore, we designed this study to learn from the students directly about their online-learning experiences, and how schools could better support all students in online-learning platforms, which led to the research questions:

1. How did the online-learning experiences differ between elementary and high-school students with diverse learning needs during the COVID-19 pandemic?
2. How did the online-learning experiences during the COVID-19 pandemic impact the motivation and engagement of students with diverse learning needs?

Methodology

We adopted an exploratory case study (Yin, 2018) to examine the independent online experiences of four elementary and three high school students in Ontario over the period of April to December 2020. The boundaries were students enrolled in K-12 online or hybrid (combination of online and in-person learning) within any school board in the province of Ontario. The criteria for participant selection were three groups of students with diverse learning needs in grade 1, grade 5, and grades 10-12, and their caregivers. These criteria enabled a rich case analysis of each student, and the opportunity for cross-analysis of students in common grades with learner

variability. After ethical review and clearance, the participants were invited through an online-learning social network. Caregivers were included in the study, because online learning was observed to require both students and their caregivers' engagement. Anonymity, confidentiality, and the voluntary nature of participation were addressed at the time of recruitment, and included parental consent and youth assent.

Data collection consisted of semi-structured interviews (Merriam & Tisdell, 2016) and online observations of learning in scheduled classes. Two interviews were conducted with each participant: one at the outset of the project, and one at the conclusion of the observation period. Interview questions focused on student/caregiver perceptions of learning modalities, communication with peers and instructors, as well as self evaluation of engagement and achievement levels. Three online observations were completed with each elementary student, while there were only two observations with each high-school student, given the differences in age and class length. The learning observations recorded the level of student engagement and comprehension of material from the researcher's perspective through the use of frequency tallies on a standardized tracking sheet. Observational data was member checked with students and the caregivers of the younger students at the end of each observation, to aid interpretation.

Descriptive coding was used to organize data from the interview transcripts and observational field notes allowing for a clear outline of what occurred in each lesson, and students' corresponding responses, in relation to the categories of engagement and comprehension (Miles et al., 2014). After the data was collected, in vivo coding was used to identify patterns from phrases commonly used by the participants (Miles et al., 2014). Since a significant portion of observations relied on the emotions and behaviours displayed by the participants, emotion coding was also adopted to explore interpersonal and intrapersonal experiences and actions (Miles et al., 2014). When codes appeared repeatedly, patterns were identified in students' responses to online learning, leading to themes which corresponded with the STD needs of relatedness, competence, and autonomy. The key themes were online learning limited students' sense of connections with peers and instructors (relatedness), the desire for structure and guidance (competence), and students' varying methods of processing information and expressing understanding (autonomy).

Findings

The purpose of our research was to explore the online learning experiences of students with diverse learning needs in elementary and secondary-school settings during the COVID-19 pandemic. Specifically, we aimed to understand the successes and challenges of students' experiences and the impact of student and engagement based on Ryan and Deci's (2020) self-determination theory. Given the unique needs of each student, and the importance of context in case-study analysis, our findings first introduce the learning profiles of each participant, and then detail the themes revealed.

Participant profiles: Strengths, needs and disabilities

A brief profile of each individual derived from initial observations and interviews with the student and their caregiver was created.

Leah (grade 1, F) was observed to be highly engaged in online learning but required constant supervision and one-on-one support. Leah was diagnosed with a neurovisual disorder and ADHD, which affected her ability in all aspects of learning. For a variety of reasons, Leah's

needs could not be met in the online learning classroom, so she returned to the physical classroom at the conclusion of our research.

Claire, (grade 1, F) was observed to be able to work independently for short periods of time without distractions, but sought affirmation of her achievements and parental support to stay on task for lengthy assignments. Claire's mother indicated that Claire does not have any disabilities, and was motivated to enrol in the online-learning school to support her social network.

Owen (grade 5, M) had been diagnosed with high-functioning autism. Owen's mother indicated that he was able to focus well within a structured schedule in the presence of a teacher, but needed supervision in the absence of a teacher during asynchronous periods. Owen returned to the physical classroom at the end of our research, because his mother felt that online learning did not adequately address his needs.

Jacob (grade 5, M) was observed to be engaged in learning when he was able to hear and comprehend the lesson. His mother told us that Jacob has a complex processing disorder making it difficult for him to attend to, and manage, multiple pieces of information. This impacted his ability to initiate and follow through on tasks without an inordinate amount of external support.

Madison (grade 10, F) expressed that she exhibits ADHD, anxiety, and specific learning disorders. Madison stated that she experienced many challenges in the way instruction was delivered in the spring, but was content with the adapted model of in-person and online learning that she received in the fall.

Sofia (grade 11, F) said that she excelled academically in the spring of 2020, with fully online learning, but struggled in the fall, when the method of instruction rotated between in-person at school and online at home. Sofia had an IEP, but all of the accommodations to support her ADHD and anxiety had not yet been implemented for the school year at the time of the research.

Dylan (grade 12, M) told us that in the fall, his course load was only two courses within a 2.5-month period in the new quadmester [2] system, but was delivered at a speed of four times the pace of his regular pre-pandemic course load of eight courses taken over the 10-month school year. Dylan expressed that he did not have any disabilities, and was learning to manage the workload challenges.

We have combined all grade/age ranges in the thematic discussion of students' experiences with online learning. Where differences arose between the elementary and secondary students within a theme, they have been noted. Individual and comparative case results have been organized by the themes: online learning limited students' sense of connections with peers and instructors, the desire for structure and guidance, and students' varying methods of processing information and expressing understanding.

Online learning limited students' sense of connections with peers and instructors

The instructional experiences observed at the time of this research limited students' ability to connect and collaborate with their peers. Regardless of age, social isolation in the students' spring and fall learning was shown to be a key factor that most negatively impacted online learning experiences.

[2] Quadmester refers to a 2.5 month period or half of a semester.

Elementary school students

The participating elementary-school students were fully online. Facing the shut down or limiting of other social pathways at this time, students indicated that connecting with others in online school as important. When describing Claire's desperate need for social connection through a teacher-directed chat room, Claire's mother stated, "The kids open the chat fast, as soon as they log on, saying "hi" … before the chat box is closed off to them." Leah attempted to connect with the teacher by raising her hand constantly, while sometimes forgetting that she needed to share turns with the others. Turn-taking was managed well in Jacob's class, since the teacher encouraged all the students to use a portable white board to write and display their answers all together on screen, essentially giving everyone a turn at the same time. Although peer connection was generally limited, Owen recalled a day when his teacher allowed the students to stay connected after class in the meeting platform. Owen said, "We could stay online as long as we wanted, so we had a challenge of who could stay online the longest."

High school students

The high-school students in our study experienced a hybrid model of online learning half the time, and learning in the physical classroom the remainder of time. During their synchronous online learning, high-school students communicated primarily using the chat box to ask questions about the course. To encourage participation within the class, Sofia's teacher awarded extra marks for completing a series of questions through the chat box. However, since direct connections between peers were limited, Sofia and her classmates used personal text messaging instead of school/teacher driven tools to connect with one another. Sofia said that she would have been receptive to small group discussions in the online breakout rooms. The second theme uncovered was the desire for structure and guidance.

The desire for structure and guidance

Four main issues related to the desire for structure and guidance emerged from the observations and interviews: 1) limited curriculum offerings, 2) sustaining engagement in an unstructured environment, 3) the need for supervision and guidance, and 4) challenges of prioritization and time management.

Limited curriculum offerings

The Ontario Ministry of Education (2020a) claimed that the full curriculum, including physical education and the arts, were critical for student engagement, mental health, and well-being. Yet, there were limited offerings of these subjects in online learning. Claire's mother stated that the absence of physical education and the arts resulted in a boring experience for Claire, as daily routine of academic subjects quickly became uneventful. Owen explained that although he did have regular physical education class, his teacher repeatedly used the same video daily, which became boring very quickly. However, Owen recalled one instance that he enjoyed where students could volunteer to turn on their webcams and lead the class in an exercise of their choosing. Jacob was the only elementary-school participant who was engaged in both regular arts and physical education. Based on observational evidence and his interview, Jacob appeared highly immersed in these activities, which he said was a nice diversion from the purely academic subjects. The structure of online learning also had an effect on students' focus, enjoyment, and level of comprehension.

Sustaining engagement in an unstructured environment

The ability to enjoy learning, focus, and understand the material were the most challenging factors related to the structure of the online environment, as the students received limited guidance from their teachers. We completed observations of the students' levels of focusing, enjoyment, and understanding using a running record of their behaviours during each observed lesson. The summary of their responses is presented in Figure 1 below.

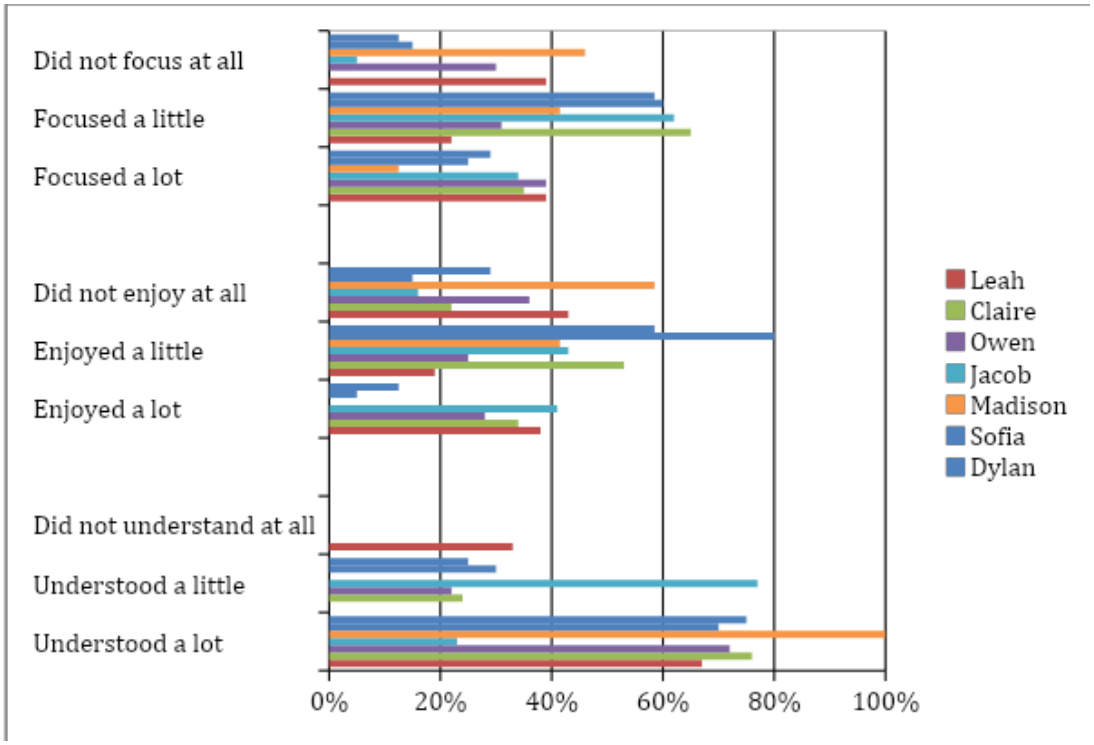

Figure 1: Observations

In Figure 1, the categories of "focused a lot," "enjoyed a lot," and "understood a lot" were used to signify a high level of engagement. All participants "focused a lot" less than 40% of the lesson, with a median of 34%. Of the elementary students, Leah and Owen had the most difficulty focussing, both recording more than 30% of the time as "did not focus at all," and not surprisingly, they moved back to the physical classroom. One of the high-school students, Madison, also "did not focus at all" 45% of the time. The level of enjoyment for each participant closely matched the focus level, with most participants who experienced a high level of focus, also reporting high enjoyment.

The ability to focus and enjoy lessons was dependent upon the nature and severity of the learning disability, and teaching style of their teachers. Sofia and Madison admitted that their struggles to focus were related to their ADHD diagnoses. In one of Madison's observations, where the teacher lectured through the webcam for approximately 30 minutes, Madison appeared to be unfocused on the lesson. She expressed that this disengagement was because the teacher "over explains," making it difficult to stay focused. Dylan reported a similar experience, indicating that when he already understood the material covered in the lesson, he found those sessions a little repetitive or boring.

In addition to ADHD, Leah (grade 1) also exhibited challenges with response inhibition through her difficulties in turn taking. Elementary classroom students were generally directed to keep cameras on for the duration of the lesson, so that the teachers could engage students and provide appropriate support. However, in one of Leah's observations, when the webcam was malfunctioning, the teacher was unable to see that Leah required additional support to redirect off-task activities.

In interviews, Owen, Madison, and Claire said that the daily routine was boring, or the work was too easy. Owen described it as "busy work" meant to keep him occupied, rather than learning. Owen indicated directly that the main reason for his lack of focus was related to the teacher's choice of not using her webcam, or allowing students to use their webcams. Owen said, "When the cameras are all off, it's hard listening or talking to a wall of black emojis."

The results for observed levels of understanding were quite different from those obtained for the levels of focus and enjoyment. For most participants, the level of understanding was much higher than the levels of focus and enjoyment, with the exception of Jacob, where the level of understanding was observed to be lower than the levels of focus and enjoyment. It appeared in describing engagement that the participants generally understood their work, but did not enjoy it, nor were they particularly focused on the learning tasks. The level of student engagement was also altered by the student's need for supervision and guidance.

The need for supervision and guidance

Elementary- school students

Some degree of adult supervision or support was generally required for younger students and those with specific learning disabilities. For example, due to Jacob's (grade 5) processing disorders, his mother established her work area directly next to his, so she could support him by partially listening to the lessons in case he missed any key instructions about his assignments. This limitation created some challenges with background noise distractions for both of them. Jacob frequently reported during the observations, "I am trying to listen to the teacher." Leah, as one of the youngest participants, also needed one of her parents to be consistently beside her in order to help her sustain attention and engagement.

High-school students

At the other end of the age range, Sofia, in grade 11, struggled with procrastination and became easily distracted. Therefore, Sofia's father initially insisted that Sofia work at the kitchen table in view of parental supervision, so as to maintain focus. After unsuccessful attempts, Sofia was motivated to prove to her father that she could succeed if given the freedom to select where, when and how she learned best. Sofia proudly reported she had increased her marks from 50 to 70% when she was able to move from the kitchen to her bedroom. For Sofia, a choice of learning environment reduced her anxiety. With these considerations of learning environments for each student clarified, we began to examine the impact of instructional methods.

Challenges of Prioritization and Time Management

In addition to the need for supervision, prioritization, and time management there were other challenging learning skills in the online environment, specifically for the high-school students. In Sofia's interviews, she expressed obstacles with the volume of independent assignments that she needed to complete. Although she portrayed a creative sense, Sofia preferred traditional written tests, rather than creative projects, because of the large workload in project-based assignments.

Madison also experienced a high level of anxiety balancing the workload of her double-credit musical theatre course in the spring of 2020. Through the support of the school's resource staff, Madison acknowledged that this experience helped her to refine her executive functioning skills (organization and planning) in the subsequent fall term. Even though Dylan did not have any specific learning challenges, he found the rapid pace of the quad semester a little challenging, and worked with a privately-funded academic coach to further develop his executive-functioning skills.

With these considerations of the desire for connections and structure for each student clarified, we began to examine the impact of students' varying methods of processing and expressing information.

Students' varying methods of processing information and expressing understanding

The students indicated that their positive or negative experiences in online learning were the consequences of the types of instructional and assessment methods offered.

We specifically examined the role of technology in providing multiple ways for students to process information and express understanding as we anticipated greater opportunities for representation alternatives than are used in brick-and-mortar schools. The teachers used Google Meet to conduct their live synchronous lessons, which included voice, text, pre-made images (drawings, diagrams, photos), and collaboratively or teacher-generated live images (video discussions, shared drawings). All students mentioned that the use of visuals to scaffold learning was their preferred format for receiving and processing information at a comfortable pace. Examples of the visuals identified included screen sharing, demonstrating the use of a website, writing on the virtual whiteboard, or a discussion accompanied with teacher-created slides. Features that were used differently by the elementary and high-school students were instructional videos, chat rooms, webcams, and break rooms.

Elementary- school students

The technology features most experienced by the elementary students were screen sharing, instructional videos, collaborative presentation tools, and gamified applications and websites. Jacob said, "I love screen sharing, as I don't like it when the teacher reads a book, but doesn't show us the book [that] she is reading. If I can't see what she's seeing, it's hard to understand." Jacob's teacher also used the Google document collaboration tool to demonstrate paragraph writing in real time, allowing for real time student-shared authoring and feedback. The instructional videos were a favourite method of presentation for the younger students, as evidenced while Leah was watching musician, Jack Hartmann, to teach her how to create the letter "P."

High-quality internet-based applications/websites were popular with students when they offered opportunities for direct interaction/feedback and fun through games. Jacob was excited in anticipation of using Knowledgehook, a math interactive website. Claire and Leah both enjoyed the audio features of Tumble Books and Raz Kids literacy sites. Leah particularly liked the gamification aspects of Raz Kids to earn rewards.

The use of breakout rooms was limited by both elementary and high-school students. The only participant in the study who experienced break-out rooms was Jacob to support his IEP accommodated needs. In relation to expression, elementary-school students preferred creative outlets to demonstrate their knowledge and understanding. Most preferred to use visual arts, kinaesthetic manipulatives, or shared technologies such as Google Slides, Google Doc, and the

creation of audio and video. When Claire was asked to complete a worksheet, she was unable to print, so she used play dough to show her work. Leah enjoyed creating videos of her reading. Although teachers promoted flexibility in the submission of assignments, students expressed a lack of follow-up and feedback received about their completed work. This resulted in a lackadaisical attitude towards work completion for Owen and Claire.

High-school students

The technology features most preferred by the high-school students were screen sharing, chat rooms, and instructional videos. The students particularly enjoyed screen sharing in conjunction with webcams, as Sofia says, "It wasn't super helpful if the webcam is all they used without actually showing us anything, as I'm a visual learner." The high-school students also stated that instructional videos were helpful, but only when they could be viewed independently, because sometimes, the internet lag caused delays, disrupting the flow, and making it hard to hear. Sofia and Dylan said that when the videos were posted on their learning platform, they could view them at their own pace and review the videos as needed for a deeper understanding.

Although the chat room was only used by Owen at the elementary level, it was a primary method of communication at the high-school level. The chat room was mostly used to ask the teacher questions, so there was little to no student-student chat. Dylan said that he preferred to use the chat room to voice communication, due to the delay in turning on and off the microphone.

For high-school students, expression of understanding was tied to formal assessment with options delimited by subject-specific needs. Tests and quizzes dominated the math and sciences subjects, with project-based assignments for social science and the arts. Generally, there were varying opportunities available to process information and express understanding.

Discussion

The outcome of our study responded to two research questions, both of which aligned with Ryan and Deci's (2020) SDT, which proposed the needs for autonomy, competence, and relatedness as essential to trigger intrinsic motivation and engagement in learning. Our first question was:

- How did the online-learning experiences differ between elementary and high-school students with diverse learning needs during the COVID-19 pandemic?

In response to this question, we found that autonomy through choice of instructional and assessment methods was important for all learners, but as could be expected, our results indicated that students in elementary and high schools had different preferences.

The second question revealed a stronger correlation with SDT regarding the need for competence through structure and relatedness through connections, especially for students with disabilities. The question was:

- How did the online-learning experiences during the COVID-19 pandemic impact the motivation and engagement of students with diverse learning needs?

We found students with disabilities faced unique challenges, especially in regard to their ability to focus, comprehend information, and work in varying online platforms. Hence, the opportunity to engage in varying instructional and assessment methods had positively influenced the outcome of learning for all the students, regardless of a student's grade level or learning needs. However, the existence of multifaceted ways to process information and express understanding was less relevant than how these methods were applied to each type of learner.

According to SDT, student's individual interests and diverse learning needs should also be considered to maintain engagement and motivation in online learning (Deci et al., 1991; Ryan & Deci, 2020).

Learning preferences differed amongst elementary and high-school students

We began our discussion with an analysis of the varying learning preferences between elementary and high-school students, before transitioning into the affect of these preferences on learner variability. The preferred method of learning was dependent on the student's grade levels and how each of their teachers used the online platforms. In the Google Meet synchronous platform, screen sharing was the method preferred by all the students, as it offered multiple means of processing information concurrently, such as teacher guidance and demonstration of materials. However, preferences of other approaches differed between elementary and high-school students.

Elementary Students Preferred More Interactive Representation than High-School Students.

When interacting with their teachers, high-school students preferred posting comments in the chat room with their webcams turned off, while elementary students favoured the opportunity for audio-visual interaction using their microphone and webcams. These variances may have been related to the need for social interaction and collaboration, as expressed through our interviews, since the elementary students had all their learning online, whereas the high-school students rotated between in-person and online learning.

Elementary students enjoyed live-streamed video-based instruction, contrary to the high-school students, who preferred to watch these videos independently. This paralleled Hogan and Sathy's (2020) findings, which also emphasized the benefits of students' access to asynchronous video recordings to increase autonomy in learning. Regardless of the similarities or differences in the presentation of instruction, the multiple choices received by the participants supported Bjekic et al.'s (2014) perspectives that students become more engaged in the use of technology when teachers used the principles of Universal Design for Learning (UDL) to provide multiple methods to represent instruction (Cast, 2018).

High-School Students Experienced Less Choice of Alternative Assessment

In relation to expression of understanding, the elementary students preferred multiple methods of assessments, but particularly enjoyed creative alternative assessments. In contrast, the high-school students were offered less choice of alternative assessment and preferred traditional tests and exams to large projects. This may be associated with the additional expectations of high-school students to manage their time in multi-step projects, which was difficult for some of the students resulting in executive functioning challenges. Therefore, it seemed like the UDL principle of providing multiple means of action and expression was less relevant to high-school students than elementary-school students in an online setting. However, in order to address the challenges of managing large projects, and increasing perceived competence, SDT emphasized the importance of well-structured environments and tasks (Chiu & Mok, 2017; Deci et al., 1992; Rhew et al., 2018).

Engagement in Online Learning was Essential for Students with Disabilities

The limited opportunities for connections with peers and instructors had the greatest impact on students with disabilities, especially those students who had difficulties with the ability to focus and had social anxiety. GAO (2020) evidenced the importance of engagement for students with social anxiety and other mental-health conditions. A lack of engagement was expressed by all participants, whether or not they had a disability. This may be related to the limited use of the interactive technology features of the online-learning platforms including, webcams and break-out rooms for peer collaboration. Herman (2020) and Hersh (2020) found that some synchronous features in Zoom, like audio, video, and break-out rooms resembled the classroom environment, and provided more opportunities to increase student engagement and motivation, especially for students with disabilities (Dahlstrom-Haki et al., 2020). In our study, the lack of engagement negatively affected the students' focus, enjoyment, and understanding of the content, resulting in two of the four elementary students opting to return to the bricks-and-mortar setting. However, Jacob's teacher demonstrated creative ways in which technology could have satisfied the UDL principle of providing multiple means of engagement, especially for students with disabilities, including the collaborative use of Google Docs and Google Slides. These strategies aligned with Do's (2018) and Sharpe's (2019) research, suggesting the effectiveness of these Google tools for both asynchronous and synchronous learning.

Although the features within the online-learning platform provided numerous opportunities for teachers to maximize the technology, keeping the learners' needs at the forefront increased the effectiveness of the online-learning experience for students with and without disabilities. Based on experiences witnessed in our study, Basham et al. (2020) also suggested the integration of UDL and technology focused primarily on the learners' needs, which may ensure that a wider range of learner variability was addressed (Basham et al., 2020).

Limitations

It is important to acknowledge that both the results and conclusions drawn from this paper were limited by teacher conditions. Due to the rapid expansion of online learning during the pandemic, the lack of technology training for the teachers may have impacted the teacher's comfort level in teaching within an online classroom.

Conclusion

Our study examined the impact of online learning in the COVID-19 pandemic on K-12 students in Ontario, based on age and learner variability. Through our observations and interviews, the need for connections to teachers and peers, along with structure appeared as most critical to supporting students' learning needs, motivation, and engagement regardless of grade level. For example, whether participants were identified with ADHD in elementary school or high school, they were challenged by distractions, the need for social interaction, and required extra support in their initiation and completion of tasks. For some participants, the lack of engagement was one of the major reasons for abandoning the online-learning environment to move back to the bricks-and-mortar classroom.

In relation to the varying methods of processing information and expressing understanding, the space and modality of online learning potentially offered a more equitable learning experience for students with and without disabilities. However, disparity occurred in the

tools preferred by, and offered, to the elementary students and high-school students.

In conclusion, we found that online learning on its own was insufficient to meet the needs of all learners in an inclusive classroom, but when consideration was given to the need for connections, structure (SDT), and varying instructional and assessment methods (UDL), a wide range of learner variability could be addressed. In turn, this integration of factors provided increased opportunities for engagement, which benefited students with and without disabilities. Since engagement and motivation were relevant in both online and in-person settings, teachers may be able to consider effective strategies shared by the students in our study for their physical classrooms post pandemic. The findings related to supporting students with diverse learning needs online may also help school boards keep the needs of all learners in the forefront when designing newly mandated online high-school courses as a requirement for graduation.

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