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# Editorial / Éditorial Volume 48 Issue 3

***M. Cleveland-Innes,*** *Athabasca University*

In this issue of the Canadian Journal of Learning and Technology, evidence-based practice continues to be emphasized, in addition to providing information reflecting trends in a rapidly evolving education space. According to the most recent Horizon Report, multiple trends overlap specifically with topics addressed in our journal: the widespread adoption of hybrid learning models, increased use of learning technologies, online faculty development, and quality online learning. We invite you to review the content summary of this journal issue.

With particular thanks to reviewer Dr. Diane Janes and Book Editor Carole Sparks, the current Book Review is a long-overdue tribute to women scholars in distance education. *The Encyclopedia of Female Pioneers in Online Learning* by former Athabasca University students Drs. Susan Bainbridge and Norine Wark provides individual histories of the work and experiences of 30 women - early adopters of online and distance education in their countries. Building on the use of "…career profiles, original interviews, and research analysis…" (p. 1), the book is a testament to the space that women in this field have occupied and continue to occupy in the modern-day world of technology enhanced global education.

The Notes Section of this issue covers a topic that links online and lifelong learning. Titled ***Time Scarcity and Student Performance: Instructional Strategies for Busy Adult Online Students,*** Melanie Holmes from the American Public University System offers a well-detailed, solution focused review of the time-greedy task engagement of online adult learning. For Holmes, adult online college students often suffer from time scarcity, which results in a drain on cognitive capacity and executive function, thus lowering their ability to plan, reason, and multitask. Busy students often engage in tunneling, ignoring everything but the most pressing concern. To support these students, educators should recommend timelines for task completion and divide larger assignments into smaller tasks. To reduce feelings of time scarcity, classrooms should have a predictable rhythm of regular assignments, a clear syllabus, meaningful assignments, and no busywork. Better understanding the challenges of the busy adult online student can help educators more effectively support their success.

Drs. George Veletsianos and Nicole Johnson of Royal Roads University identify technological and other challenges facing Canadian university faculty in Article 1; ***Canadian Faculty Members' Hopes and Anxieties About the Near-Future of Higher Education.*** They identify the challenges

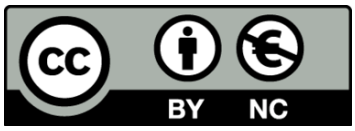
spanning from economic, social, technological, demographic, environmental, to political tensions that are part of the higher education pace worldwide. This has resulted in a call to rethink, reimagine, and reform higher education. To respond to such challenges, a wide variety of stakeholders must be engaged. Thirty-seven faculty members at Canadian colleges and universities share their hopes and anxieties about the future of higher education. Results centred on four themes: (1) anxieties and hopes shaped by supports and resources from various sources, (2) faculty member anxiety over matters that negatively impact them but are beyond their control, (3) faculty member hopes that "good" comes from the COVID-19 pandemic, and (4) visions of a well-rounded education for students to succeed both within and beyond their careers. Implications speak to a need for research toward more hopeful futures for higher education, especially in the context of online and blended learning.

L'article 2 teste la ***Utilité des fonctions d'aide technologique sur les performances en lecture et en écriture et sur le concept de soi scolaire auprès d'élèves du primaire qui ont des difficultés d'apprentissage / Usefulness of Assistive Technologies for Reading and Writing Skills and Academic Self-Concept for French-Speaking Elementary Students with Learning Difficulties.*** Focused on students rather than instructors, Bourget-Piché, Leroux Chemla, Bigo, and Guay report findings on the use of assistive technologies (AT) by French-speaking elementary school students experiencing reading and writing difficulties. These authors test whether AT improved reading comprehension, spelling errors, and academic self-concept compared to a group of average achieving peers. The results show that between the two time periods, students in the AT group reduce their spelling errors, and after just five months using AT, achieved performances comparable to their average achieving peers. The implications for academic success and future research are discussed.

Jones and Cheng of Queen's University and Tweedie from the University of Calgary continue the use of artificial approaches in Article 3, ***Automated Scoring of Speaking and Writing: Starting to Hit its stride.*** First, it surveys the current research on automated scoring of language, then it examines how automated scoring impacts assessment, teaching, and learning in the present and future. By outlining the general background of automated scoring issues in language assessment and testing, the authors can position the research with respect to technological advancements. A detailed literature review search process and criteria for article inclusion contextualizes the emergence of three main themes: automated scoring design considerations; the role of humans and artificial intelligence; and the accuracy of automated scoring with different groups. The next steps for automated scoring of language in the Canadian context related to both the research and current uses are described.

Stoesz and Niknam of the University of Manitoba report on user interface visual design and student learning experiences. ***Student Perceptions of the Visual Design of Learning Management Systems*** is a preliminary examination of students' perceptions of the visual design of an LMS and their learning experiences. Using survey methodology, findings identify multiple correlations, including that students reporting positive perceptions of the visual appearance of the LMS also report greater satisfaction with grades. Exploring the impact of LMS colour and other dimensions of visual design on student engagement and learning are important and have practical value for LMS developers, instructional designers, and instructors.

Article 5, ***Rhizo-Creation of Second-Language Teachers' Capacity for Technological Integration*** is authored by Francis Bangou of the University of Ottawa. Looking again at language learning, they report findings from an ongoing research project associated with the design and delivery of a 12-week online graduate course in computer-assisted language learning. Data includes participants' assignments, semi-structured interviews, and course materials. Rhizoanalysis was deployed to map change and potentialities in teachers' becoming. Technology, learning, and teacher education relate to re-theorizing the role and effect of human, expressive, and material elements in teacher education using computer-assisted language learning, where micro-level singularities and emergent potentialities for teaching and learning with/in teacher education exist.



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# The Encyclopedia of Female Pioneers in Online Learning, 2023. By Susan Bainbridge and Norine Wark. Routledge. 492 pages. ISBN 978-1-003-27532-9 (ebk)

**Reviewed by*: Dr. Diane P. Janes,*** *Thompson Rivers University*

## Introduction

*The Encyclopedia of Female Pioneers in Online Learning* by Drs. Susan Bainbridge and Norine Wark is an overview of the work and experiences of 30 women - early adopters of online and distance education in their countries (although even they struggle with what to call their focus of study and practice, as discussed in Chapter 32). Building on the use of "…career profiles, original interviews, and research analysis…" (p. 1), the book is a testament to the space that women in this field, have occupied and continue to occupy in the modern-day world of technology enhanced global education. The book is divided into two parts.

## Part One

When I was first approached to write a review of this book, I was struck by how many of the women noted in its pages, that I had either met or read about (as early authors in a field that I called my own) and then by how many I had not encountered in my 25+ year career in online and distance learning.

The process for adding a woman to this work was detailed and systematic. In Chapter 1, Initial Thoughts, the authors describe how they began the conversation which ultimately became this book; the work on women in this field in any part of the world was scant at best, and nonexistent at worst. Their original thinking of a wide exploration of females in distance education was soon seen as somewhat hopeless, and they quickly were moved to see that "…the authors needed to focus on female pioneers of online learning [as] This was the era…where the greatest number of female pioneers were still alive and able to tell their stories in their own words" (p. 4).

To arrive at the 30, they started a list of possible women; they created guiding terms and definitions that they felt were in line with being a pioneer and they combined these terms and

definitions with the idea that the "…potential candidate[s] had to have initiated their founding activities somewhere between 1970 and 2000" (p. 5) with the year 1980 as the date where they began to work in the field (p. 396). If they included someone who began their work after the year 2000 it was with the understanding that online learning was new to their country or was "…novel in some respect" (p. 5). After starting with their initial list of potential interviewees, the authors asked those early interviewees to offer up the names of women they saw as pioneers, and so the list grew, and then was again narrowed down to 30 for this work. They were limited to the English language as the main communication medium, and to those pioneers who were well enough to agree to participate.

In total, Bainbridge and Wark interviewed women from the countries of Argentina, Australia, Canada, China, Germany, India, Indonesia, Israel, Korea, Marshall Islands, Namibia, New Zealand, South Africa, Sri Lanka, USA, and West Indies, with several of the interviewees having significant work and practice connections in multiple countries during their careers.

Each subsequent Chapter, 2-31, contains a full list in alphabetical order by last name of the women interviewed as well as the interview itself, a transcript analysis summary and the transcript of the interview, in addition to the interview questions and a detailed publication summary for each woman. Using the QR code provided, readers can access the actual interview recording located on YouTube. The content and structure for each interview is detailed and follows the same pattern for each interview.

## Part Two

Initially, when I began the review of this book, I was unsure of the necessity for this second part. As someone with a background in history and a strong bias toward narratives and stories, I was wanting to hear the raw experiences of the women and wondered to what end the final section (Chapters 32-33) could add to this already rich trove of anecdotes. As a researcher, however, I also wanted to know more about how this work was accomplished. And these two final chapters satisfied that side of my inquiry.

In the first part of Chapter 32, the authors detail the methodology used, the research questions they posed, and the depth used to select the interviewees, and coding used in their thematic analysis. Themes ranged from background, benefits of distance learning and learning environment to challenges, accomplishments, interesting memories, and so on (p. 399). Each theme, once identified by the authors, was then explored in more depth further in the Chapter.

The final chapter, Final Thoughts, is thought provoking and worth follow up and analysis in its own right. They explore the Matilda effect (coined by Rossiter in 1993), which was described (and quoted in this work) as ""[T]he more [a] women worked the more the men around her profited and [the] less credit she got" ([Rossiter, 1993,] pp. 336-337)" (Bainbridge & Wark, 2023, p. 333). They go on to cite examples found within their own work on this volume that are suggestive of the Matilda effect in play. This phenomenon is worth a fuller examination. This

final chapter is, I feel, a call for other researchers to start to examine some of the issues discussed in Chapter 33 as it pertains to the work of women in online learning around the world.

## Conclusion

Overall, this work is a rich and rewarding read. The depth, breath, and individual experiences of each of these pioneers is on display for all to see. They are a collection of the wealth of past knowledge and history; and for future generations of women in online learning, they are a pathway to the future. The issues that surround these pioneers and how their work was disseminated is also worth exploring.

This book, however, has only scratched the surface, and I hope that if Bainbridge and Wark have not already begun the work to add to this list of pioneers (the authors hint, on p. 488, that they have currently 47 further possible interviewees so that a second volume is possible), then hopefully someone has reached out to them to continue this work.

Even in the time between the interviews and the publication of this work, two pioneers have left us – the work is dedicated to them – Chere Campbell Gibson (1945-2020) and Chandra Gunawardena (1940-2021).

There are many more voices to be heard from women in this field, and time waits for no one.

I look forward to continuing to hear these voices!

## References

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# Time Scarcity and Student Performance: Instructional Strategies for Busy Adult Online Students

# Manque de temps et performance des étudiants : Stratégies d'enseignement pour les étudiants adultes occupés en ligne

***Melanie Holmes,*** *American Public University System*

**Abstract**

Adult online college students often suffer from time scarcity, which results in a drain on cognitive capacity and executive function, thus lowering their ability to plan, reason, and multitask. Busy students often engage in tunneling, ignoring everything but the most pressing concern. To support these students, educators should recommend timelines for task completion and divide larger assignments into smaller tasks. To reduce feelings of time scarcity, classrooms should have a predictable rhythm of regular assignments, a clear syllabus, meaningful assignments, and no busywork. Allocating points for preparatory tasks affirms their value and demonstrates respect for students' time. Educators can help students build slack into their schedules so that they can better navigate disruptions by recommending multitasking strategies, suggesting rules of thumb, highlighting key points in instructions, and distinguishing essential from non-essential resources. Better understanding the challenges of the busy adult online student can help educators more effectively support their success.

*Keywords*: Online education; Time scarcity; Mental bandwidth; Adult education

**Résumé**

Les étudiants adultes des universités en ligne souffrent souvent d'un manque de temps, ce qui a pour effet d'épuiser leur capacité cognitive et leur fonction exécutive, réduisant ainsi leur capacité à planifier, à raisonner et à faire plusieurs choses à la fois. Les étudiants occupés s'engagent souvent dans des tunnels, ignorant tout sauf la préoccupation la plus urgente. Pour aider ces élèves, les éducateurs devraient recommander des délais pour l'accomplissement des tâches et diviser les gros travaux en petites tâches. Pour réduire le sentiment de manque de temps, les salles de classe devraient avoir un rythme prévisible de devoirs réguliers, un plan de cours clair, des devoirs significatifs, et ne pas être occupées. L'attribution de points pour les tâches préparatoires affirme leur valeur et démontre le respect

du temps des élèves. Les éducateurs peuvent aider les élèves à prévoir du temps libre dans leur emploi du temps afin qu'ils puissent mieux gérer les perturbations en recommandant des stratégies multitâches, en suggérant des règles empiriques, en soulignant les points clés des instructions et en distinguant les ressources essentielles des ressources non essentielles. Une meilleure compréhension des défis auxquels est confronté l'étudiant adulte en ligne peut aider les éducateurs à soutenir plus efficacement sa réussite.

*Mots-clés*: bande passante mentale ; l'éducation en ligne ; manque de temps ; l'éducation des adultes

## Introduction

She looked over her calendar with some satisfaction, certain that she had plenty of time to complete her workday at the office, drive her youngest to volleyball practice, put supper on the table, and study for the exam due tomorrow in her online class. A flurry of texts later, announcing that her in-laws were coming for a surprise stopover, her oldest needed an emergency dental visit, and that the dog had apparently eaten the television remote, she was no longer sure that she was going to have any time to study. Adult online college students must often juggle multiple demands on their time and navigate time scarcity. On the surface, this is a time management issue; however, being busy is also a significant burden on our mental bandwidth, a term used by behavioural scientists Mullainathan and Shafir (2013) to describe the cognitive load that impairs our ability to focus, prioritize tasks, and think clearly. When we are distracted by a constant hum of things that require our attention and the feeling that we will never catch up, we are not as efficient and capable as when we feel like we have enough time. Understanding this drain on the mental bandwidth of adult online students opens an opportunity for course developers and instructors to shape the learning experience to empower busy students.

In 2020, 7.0 million undergraduate students were exclusively enrolled in online courses in the United States compared to 2.4 million the year prior (U.S. Dept. of Education, 2021). Add to that the millions of graduate students and students taking only some of their courses online, these numbers put into perspective the surge in popularity of online courses during the pandemic. According to statistics kept by the U.S. Dept. of Education, most universities who moved courses online as an emergency measure during the COVID-19 pandemic expect to continue offering online courses after the crisis is over. While the pandemic forced many universities to provide online instruction sooner than planned, it merely pushed forward the timeline on a trend that was already in place. Online education had already become a mainstream mode of instruction and, over the last decade, was "the main source of enrollment growth in American higher education" (Ortegus, 2017, p. 47). In part, this growth occurred because the flexibility of online education appeals to adults who want to work towards their degree while staying in the workforce and/or raising their children.

There is little data on how time scarcity impacts student success, possibly because educators hold onto the idea that the attention of post-secondary students is (or should be) squarely focused on their studies. However, for many adult online students, being a student must jockey for position against being a parent, spouse, and employee (Ortagus, 2017). These students are taking classes online because

they are already busy. Another common myth is that working students have ample time to study on the weekend, which fails to recognize that family responsibilities surge on weekends. At Leeds Beckett University, two research projects on the learning behaviours of online students demonstrate that

> the study habits of those with families as the dominant contextual factor were characterised by lack of structure owing to childcare and extra-curricular activities . . . The research showed that distance learners with families tended not to study much over the weekends, unless they did not get time to study during the week. (Hewson, 2018, p.4)

Weekend schedules are less predictable for working parents and care responsibilities often take priority.

## Cognitive Impacts of Time Scarcity

Managing the time crunch is only part of the solution since busy adults also find themselves weighed down by an involuntary focus on the time scarcity that pulls at their attention and detracts from the ability to focus (Larrson et al., 2017). Just knowing that time is limited generates an internal disruption that prevents someone from fully focusing on the task at hand. As Mullainathan and Shafir (2013) conclude, "scarcity directly reduces bandwidth—not a person's inherent capacity but how much of that capacity is currently available for use" (p. 47). The term *bandwidth* encompasses both cognitive capacity, which are the mental functions related to problem solving and reasoning, and executive control, which includes planning, impulse control, multitasking, and memory. The same person who can function well without time pressure, will lose "between 13 and 14 IQ points" when preoccupied with time scarcity (Mullainathan & Shafir, 2013, p. 52). So, not only does being busy impair adult online students' ability to find time to complete course work, knowing that the schedule has very little slack built into it reduces students' ability to make a plan, remember new information, and reason through assessment tasks, thus putting them at a distinct disadvantage. Even when students are unaware of the tax on their bandwidth, it is impairing their ability to think clearly and function well.

Time scarcity triggers a coping mechanism in the brain that Mullainathan and Shafir (2013) call *tunneling*, ignoring everything but the most immediate concern. Because busy students are tunneling, they are not thinking ahead and do not feel like they have enough time to pay close attention to a lot of information. As Jabs et al. (2007) have observed, busy adults often find themselves reacting rather than thinking ahead, in part because "planning takes time, energy, and forethought and therefore competes with time for other activities and demands" (p. 23). Ironically, tunneling can prevent students from seeing strategies that would help them save time, thus requiring them to spend longer on tasks that are completed more quickly by students who have a larger time-budget (Zhao & Tomm, 2018). From the outside, students who are tunneling might show the same characteristics as students who are procrastinating, namely assignments being submitted for review at the last minute and/or showing evidence of being completed hastily. The difference is that students who are tunneling are overwhelmed by a busy schedule and will take advantage of instructional support that helps plan the week for them. In addition to weekly posting reminders of upcoming assignment due dates (Van der

Meer et al., 2010), educators can support student success by posting a recommended timeline of the interim steps required for completion. For example, if two quizzes, a project proposal, and an article summary are due by Sunday, the proposed timeline might stagger the due dates throughout the week and specify that time should be made to think about the project topic and read the article. Proposing a plan of action for students works with their tunnel vision and directs them towards a path of completion while still allowing them flexibility. Ariely and Wertonbroch (2002) suggest that even when encouraged to make a plan, students do not set self-imposed deadlines optimally, which suggests that all students might benefit from some support in this area.

## Mitigation Strategies

In a similar vein, large assignments should be divided into smaller tasks. For people suffering from time scarcity, a distant deadline is easily put aside as more pressing concerns take priority, eventually resulting in last-minute panic when the due date arrives (Lynch & Zuberman, 2006; Mullainathan & Shafir, 2013). Mullainathan and Shafir (2013) conclude that "frequent interim deadlines have a greater impact than a single distant deadline" (p. 172). In the classroom, when smaller tasks build towards a larger project, students will benefit from a checklist that takes them step-by-step through the process, so that they can both see how the tasks support course objectives and they can save the file to take away a solid plan for use in future courses. Having more frequent assignments also opens possibilities for instructors to connect with each student on a regular basis to motivate them, monitor their progress, and guide their learning efforts. Depending on the specific learning needs in each field of study, there might be advantages to allowing students time to think about their submitted work for a few days before receiving feedback (Fyfe et al., 2021). Nonetheless, tunneling makes it difficult to value a distant reward and, particularly at the start of the semester, more immediate feedback will keep students engaged.

Implementing strategies that work with tunneling can help students find their footing in the online classroom. However, they should also be nudged away from tunneling. The first step towards reducing feelings of time scarcity involves helping adult students feel more in control of the time they have available. Award-winning educator Sarath A. Nonis (1997) goes as far as saying that instructors should do "everything possible" to make students believe that they are in control of their time and no surprises are going to appear during the semester to derail their progress (p. 31). To that end, the syllabus should include course objectives, required course materials, weekly tasks, due dates for all assessment tools, and the relative weight of each assessment towards the final course grade. Instructors should avoid pop quizzes or changing due dates once the semester has started. Ensuring that there are regular, consistent due dates for assignments helps students plan their week more easily around them. Nonis (1997) suggests that requiring students, particularly those who struggle to manage their time, to keep up with a steady, predictable workload of weekly shorter assessment tasks rather than infrequent large assignments "may result in higher levels of perception of control over time" (p. 31), which ultimately results in higher success rates. Providing realistic time estimates on how long each task should take allows students to budget enough time to complete them and helps them avoid belabouring

minor assignments at the expense of time that should be spent on major assignments (Kapoor et al., 2021). Even if the information is in the syllabus, students might not judge that reading through the syllabus is a good use of their time, either because they are too busy or because they have been in previous courses where the syllabus was less well-organized. So, instructors should consider ways to walk through the information in the syllabus with students to show them how they can use it to prepare for the semester, how assessment tools work together to accomplish course goals, and how to evaluate the relative weight of assessment tasks towards the final grade. Having this information helps students see the big picture and place value on their time and effort. Ultimately, students who feel in control of their time are less stressed, more productive, and stronger academic performers (Nonis, 1997; Kapoor et al., 2021).

Adult students benefit from knowing that their time is respected. In academia, there is an understandable reluctance to treat students as consumers; nonetheless, in choosing to add coursework to an already full schedule, students are making a high-risk choice in how they are going to spend their time. According to Hewson (2018), there is a "high opportunity cost of time if the student makes the wrong choice; failure means wasting a year, other opportunities not taken" (p. 10). Adult online students make sacrifices to make time for their studies. Thus, course developers and instructors should demonstrate respect for students' time. Avoid assigning busywork, tasks that have limited value towards accomplishing the course objectives. Provide robust lessons and do not rely on the textbook to do all the teaching. As one of the graduate students in Firm Faith Watson's study of effective instructional strategies said, "Provide structured guidance rather than textbook assignments. I don't need to pay [tuition] for someone to tell me to read a book" (Watson et al., 2017, p. 424). Engagement with the instructor is at the heart of learning, even more so when students are online; they want to know that they are not alone on their educational journey, and they value an instructor who is "available and responsive" (Watson et al., 2017, p. 424). Instructors should provide meaningful and affirming feedback in discussions and on assignments. Identify both strengths and weaknesses in student work and offer concrete feedback on how students can strengthen their skills. When determining how much weight to give assignments towards the final grade, instructors should set students up for success by assigning enough value to preparatory work so that students do not "make a strategic decision to forego those marks and instead focus their time on other pieces of assessment" (Cook & Babon, 2016, p. 26).

Many adult online students have been out of school for a while and might not feel entirely confident in their ability to succeed. A lack of confidence compounded with time scarcity negatively impacts students' coping abilities; their subsequent use of maladaptive coping strategies puts them further behind and increases their frustration. Additionally, "poor decision making or impulsivity caused by scarcity's depletion of cognitive resources" and increased feelings of self-blame negatively impact their ability to regroup and recover (Mitsui, 2022). Guiding students towards effective time management and academic success will increase their confidence and further reduce their stress, thus resulting in a positive cycle of achievement. In some cases, this will involve placing value on tasks that the instructor recognizes as a wise use of time, but that students might dismiss as unnecessary. Thus, enough points must be allocated towards these tasks that students recognize their importance. For example, it might not feel intuitive for our online student to take notes when all the information is

readily available to them in digital form (Morehead et al., 2019). Cook and Babon (2016) conclude that although students understand the value of studying and being prepared for class, "this is generally insufficient motivation . . . particularly when balancing competing demands on their time" (p. 25). Nonetheless, research suggests that taking handwritten notes encourages more effortful processing of course materials, resulting in more rewarding in-class discussions, higher test scores, and improved feelings of self-efficacy. Peverly et al. (2003) determined that "college students typically have a poorly defined metacognitive sense of how prepared they are for an examination" (p. 343) but taking notes can help students understand the material and identify when they would benefit from extra research. In fact, between allowing more time to study or requiring students to take notes, Peverly et al.'s research determined that having extra time was not a good predictor of success, but notetaking was. Liles et al. (2018) determined that medical students who earn C grades often rewatch online lectures as part of their study process, but students who earn A's rarely do; instead, they rely more on their handwritten notes. To ensure that students are reviewing preparatory materials, Cook and Babon (2016) recommend weekly quizzes with timely feedback from the professor be used to incentivize learning so that students are "more engaged in the learning process," "more fully understand the course material," and feel "pride in their achievements" (p. 26). Peverly et al.'s research suggests that requiring notetaking can also accomplish these goals, and technology has advanced so that even handwritten notes are easy to scan and submit for assessment by tablet or smartphone. Requiring students to take handwritten notes teaches valuable study skills, fosters mastery of preparatory materials, improves grades, and boosts student confidence, which ultimately assures students that they are making good use of their time.

## Supporting Effective Time Management

In conjunction with helping students feel more in control of their time, instructors can recommend strategies to use time more efficiently and help students build slack into their schedule. Having some slack, "a buffer for the unexpected but predictable crises that vex our lives" (Loxterkamp, 2014), reduces stress and empowers students to handle minor disruptions to their plans. However, busy students often fail to consider whether there are better ways to accomplish their tasks. A study of students who were combining academics with intense athletic training to prepare for the Beijing Olympics revealed that when the athletes had to make difficult choices about how to manage their time to balance multiple goals, they did not carefully consider various options or assess alternatives; they acted based on how they had handled similar situations in the past (Macquet & Skalej, 2015). Using this strategy, first-year students were at a considerable disadvantage because they had not yet learned effective strategies to manage the sudden restrictions on their time that came from being an elite athlete. Effective multitasking can be a helpful strategy, and numerous examples are provided across the literature. Jabs et al. (2007) explain that busy parents frequently mention juggling competing activities and trying to accomplish more than one thing at once. Hewson (2018) notes that some students "listened to course-related audio recordings over their tablet or phone while cooking" (p. 4) and Farrell and Brunton (2020) explain that one of their study participants was a mother of 5 who kept books in her car so she could study while she waited at football practice. As long as one activity

requires little focused attention, it is possible to also use that time for studying or reviewing course materials. Providing electronic materials for students makes it even easier since most students carry a phone with them. Depending on the subject matter, courses might also provide audio books or podcasts to allow students to listen to the course readings while they do something else with their hands like folding laundry or loading the dishwasher. Attentive listening is a learned skill, so students should be reminded that they might need to practice before it begins to feel comfortable. It might also be worth a reminder that "effective multitasking" does not mean watching the latest streaming miniseries while attempting to study for an exam or listening to a podcast while operating heavy machinery. There are tasks that require focused attention. Media multitasking (like interrupting study time to post on social media or send a text) should be strongly discouraged as it has a negative effect on "GPA, test performance, information recall, comprehension and note-taking" (May & Elder, 2018). Multitasking works best when applied with a healthy dose of common sense.

Another way to maximize time is to provide tips on how to use 10 or 15 minutes if students have a break in the day or if the hour they had hoped to have for course work has been downgraded to a shorter time frame. Giving that extra boost of confidence to assure students that they can accomplish something useful in small segments of time motivates students to take advantage of all available moments. Jabs et al. (2007) suggest that those with more confidence in their abilities might feel that there is enough time to accomplish tasks at the end of a rushed workday whereas for those with low self-efficacy "time may have been a major barrier" (p. 23). Their research points to the intersection between fatigue, discouragement, and lack of time. The problem is not only that students are busy; it is that being busy often comes alongside other drains on their energy and motivation. As one student explains, the experience of scarcity prompts "mistrust within yourself as far as what you know, what you can accomplish, what you're capable of knowing, learning, doing" (De Sousa et al., 2018, p. 70). In these moments, having a short assignment or task that can be completed, helps students feel productive, encouraged, and motivated. Some of these tasks might involve spending a few minutes thinking about essay or project topics and jotting down ideas, so that students are prepared to jump right into larger assignments when they have more time. Video lectures might also be divided into 15-minute segments, which has the added benefit of aligning with research that suggests student attention begins to decline between 10 and 15 minutes into a lecture (Bradbury, 2016). Instructors should consider how students can best use 15 minutes of focused attention and help them make good use of that time. This is not to say that all course materials should be chunked into 15-minute segments; students will still need to find larger spans of time to focus on lengthier tasks or tasks that require more sustained attention. However, identifying some tasks that require less time can keep students engaged in the classroom even when they are busy, and accomplishing those tasks boosts confidence and works with the time constraints of the adult online student.

## Time and Bandwidth

The flip side of making available time more productive is that there is slack in the schedule that gives students greater ability to manage disruptions. When students are "time poor," things like illness, weather events, and holidays can derail their progress and have "a domino effect on participants' ability to keep on track with their studies" (Farrell & Brunton, 2020). Supporting students by anticipating such events (when possible) and putting a plan in place to work around the disruption bolsters student success. Instructors should be mindful of weather events or natural disasters that might impact students and offer a plan to work around the disruption. Since many online colleges and universities work through holidays, remind students at the beginning of the semester of upcoming events and encourage them to plan ahead to make time to celebrate with friends and family. Additionally, providing help at the right time "can serve to purchase peace of mind. And that peace of mind allows the person to do many more things well and to avoid costly mistakes" (Mullainathan & Shafir, 2013, p. 179). In the classroom, help at the right time might include offering a late pass that students can use when it is needed (Schroeder et al., 2019) or dropping the lowest quiz score. Research suggests that simply knowing that there is an option to alleviate scarcity changes perception and increases our sense of personal agency. We perceive endeavors as less risky, believe that negative outcomes are less likely, and become more patient even though "nearly all individuals with greater agency do not exercise it" (Gneezy et al., 2020). Keep in mind that though an extension for one student facing a specific time constraint can be helpful, blanket extensions on deadlines are not uniformly helpful as they introduce uncertainty about the course schedule and encourage students to defer task completion. Ideally, course developers and instructors should create a steady, regular pace that promotes cumulative learning and allows space for flexibility and rest.

Many instructional strategies that save both time and bandwidth are already part of best practices like providing "clear instructions for completing coursework; criteria for assessment of assignments, exams and quizzes; and evaluation of overall performance" (Watson et al., 2017, p. 424). When course materials and assessment activities are organized effectively, students can easily identify the tasks that need to be done and understand how best to complete them. Mullainathan and Shafir (2013) note that we are relatively comfortable working with a budget when short on cash, but we are not as accustomed to budgeting with limited available bandwidth. They note the "impulse to educate" where we throw a lot of information at people and then wonder why they are not acting on this information (p. 174). Busy adults often have many obligations and worries on their minds. Though some never reach the limits of their bandwidth, others know the feeling of having reached the end of their mental energy for the day. For someone who has maxed out their available bandwidth, their fingers might be clicking through the digital classroom, but they are struggling to absorb complex information through their mental fatigue.

One way to economize on bandwidth is to bolster more complex calculations with good rules of thumb. These might be shortcuts that are well-known in industry practice though less often discussed in academic settings. For example, in composition courses, instructors recommend roughly verifying the organization of an argument by using a small font size to see the whole essay at a glance. If paragraphs

are of approximately equal size, the organization is likely to be balanced. If not, students will need to invest time into organizing their argument more effectively. When researching, we encourage students to look in the introduction and the conclusion for the thesis statement in the research articles. A quick look at the thesis statement will help them determine if the article is relevant for their research needs. These rules of thumb provide efficient short cuts for busy students. Mullainathan and Shafir (2013) discuss changes made for a financial literacy course given to microentrepreneurs and the dramatic success when the standard training module was replaced by a course built around good rules of thumb: "Revenues—actual business sales—went up for the rules-of-thumb graduates, especially in bad weeks when improved practices can matter most: they had 25 percent higher revenues in those bad weeks. Traditional financial literacy training, in contrast, had no impact" (p. 175). These tips are even more important to pass on to online students because this is the kind of information that is often conveyed to in-person students as asides during lectures or in conversation after class. Building them into online lessons adds value for students.

## Clear Direction

Another way to help students budget their bandwidth is to clearly distinguish essential information in the classroom. Course developers should avoid flooding the weekly lessons with extra, optional readings, or tabs linking to interesting (but non-essential) information. Make it easy for students to identify the information they need. Place optional resources in a separate area and clearly identify their purpose so that students can see at-a-glance how those resources might be relevant to their learning goals. Van der Meer et al. (2010) note that "extra," "optional," or "recommended" readings can be a significant point of confusion in the classroom because instructors might say that readings are optional and then test that material on the exam, or they might recommend materials for interests' sake that prove to be unnecessary for the completion of assessment tasks. Making the value of these course materials explicit means that students do not waste mental energy guessing what they are supposed to do with them. If there are learning support measures such as tutoring, podcasts on using library resources, or meetings with academic advisors that are strongly encouraged, consider registering students automatically unless they choose to opt-out. Doing so sends "a strong message to all students about the importance of using these services" (Serventy & Allen, 2022).

In assignment instructions, provide both full explanations of how to complete the task and a succinct overview of the key points. Adult online students are likely to be in and out of the assignment multiple times while they work on it. Highlighting the key points allows students to have the benefit of the full explanation and a quick reminder of the assignment requirements when they return to the task after a break. Encourage community so that students see one another as helpful resources (Covelli, 2017) and the professor as engaged and supportive (Nonis, 1997; Watson et al., 2017). Research by Shaikh and Cruz (2022) suggests that when people are feeling time constraints regarding task completion, they are more likely to turn to digital technologies for quick help, even when they are told those technologies are unreliable, and they are less likely to communicate with members of their team. The use of technology was perceived as a "type of mental shortcut" though using such assistance

generally resulted in underperformance on creative tasks. Emphasizing the reliability and utility of support from classmates and the professor helps students find more effective solutions. Even when students choose not to take advantage of extra support, knowing that they have options to ask questions, get another opinion, or discuss their ideas can reduce the drain on their bandwidth and help them feel more empowered. To some extent, supporting busy and overwhelmed students means reducing the number of decisions they must make or making those decisions easier. Dubey's research (2019) has determined that mental fatigue has a direct correlation to the number of decisions that must be made each day in addition to the number of hours worked. He suggests that cognitive overload can be reduced for working professionals taking online classes with a simple user interface in the digital classroom and clear explanations from the instructor. A student who knows exactly where resources are and how to complete an assessment task does not have to waste time and mental energy trying to figure it out. With limited bandwidth available, it should be focused on mastering course objectives, not puzzling through confusing instructions or getting lost in a sea of information.

## Conclusion

Working with students to effectively use the time that they have is a better option than holding out hope that our students will consistently find hours of quiet, uninterrupted time to complete their course tasks. Students who feel pressed for time will tunnel, which reduces their ability to make a good plan, think clearly, and reason effectively. Instructors can work with this tunneling tendency and help students feel more in control of their time by providing a steady predictable schedule and breaking larger assignments into small tasks. Doing so reduces student stress and increases their academic performance. Instructors and course developers can be students' allies by demonstrating respect for their time and giving them the tools they need to be successful. Help students build slack into their schedule through effective multitasking and making full use of even short spans of time so that they have time to rest and can also handle disruptions to their schedule. In addition to time management skills, the busy adult online student benefits from strategies including clear instructions, easily accessible resources, rules of thumb, and an uncluttered digital classroom. These strategies reduce the drain on their mental bandwidth and help them focus on accomplishing course objectives. When we, as instructors and course developers, have a better understanding of the kinds of pressures faced by our busy students, we are in a better position to support their efforts and help them flourish on their academic journey.

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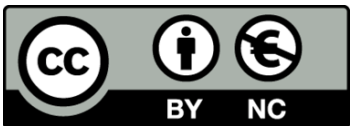

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# Canadian Faculty Members' Hopes and Anxieties About the Near-Future of Higher Education

# Les espoirs et les inquiétudes des membres du corps professoral canadiens concernant l'avenir proche de l'enseignement supérieur

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**Abstract**

Higher education worldwide is facing several challenges spanning from economic, social, technological, demographic, environmental, to political tensions. Calls to rethink, reimagine, and reform higher education to respond to such challenges are ongoing, and need to be informed by a wide variety of stakeholders. To inform such efforts, we interviewed thirty-seven faculty members at Canadian colleges and universities to develop a greater understanding of their hopes and anxieties about the future of higher education as they considered what higher education may look like five years into the future. Results centred on four themes: (1) anxieties and hopes are shaped by supports and resources from various sources, (2) faculty members face anxiety over matters that negatively impact them but are beyond their control, (3) faculty members hope that "good" comes from the COVID-19 pandemic, and (4) faculty members hope for a well-rounded education that will enable students to succeed both within and beyond their careers. Implications for these findings suggest a need to direct research efforts and practices toward more hopeful futures for higher education, especially in the context of online and blended learning.

*Keywords*: Anxieties; Faculty members; Learning futures; Qualitative research; Hopeful futures

**Résumé**

L'enseignement supérieur dans le monde entier est confronté à plusieurs défis allant des tensions économiques, sociales, technologiques, démographiques, environnementales et politiques. Les appels à repenser, réinventer et réformer l'enseignement supérieur pour répondre à ces défis sont en cours. Ces efforts doivent être éclairés par une grande variété d'intervenants, y compris les membres du

corps professoral. Pour éclairer ces efforts, des entrevues individuelles ont été menées auprès de trente-sept membres du corps professoral de collèges et d'universités canadiens afin de mieux comprendre leurs espoirs et leurs inquiétudes quant à l'avenir de l'enseignement supérieur lorsqu'ils réfléchissaient à quoi pourrait ressembler l'enseignement supérieur dans cinq ans. Les résultats sont centrés sur quatre thèmes : (1) les anxiétés et les espoirs sont façonnés par des soutiens et des ressources provenant de diverses sources, (2) les membres du corps professoral sont confrontés à de l'anxiété sur des questions qui les touchent négativement, mais qui sont hors de leur contrôle, (3) les membres du corps professoral espèrent que des effets positifs vient de la pandémie de la COVID-19, et (4) les membres du corps professoral espèrent une éducation bien équilibrée qui permettra aux étudiants de réussir à la fois dans et au-delà de leur carrière. Les implications pour ces résultats suggèrent le besoin d'orienter les efforts et les pratiques de recherche vers un avenir plus prometteur pour l'enseignement supérieur, en particulier dans le contexte de l'apprentissage en ligne et hybride.

*Mots-clés*: inquiétudes ; membres du corps professoral ; avenir de l’apprentissage ; recherche qualitative ; avenir prometteur

## Introduction

At a time of rapid technological change and socio-political turmoil, compounded by nearly two years of teaching and learning in a pandemic context, many are speculating about what the future of higher education may hold. For instance, Zimmerman (2021) offers a hopeful outcome in his telling of a short fictional story of Professor Van Winkle, who awoke from a nap to find himself in the year 2041. Previously frustrated by political polarization, Van Winkle finds himself in a new era of pedagogy where students, still learning in an on-campus setting, are well-versed in the practice of viewpoint diversity and use technology to facilitate respectful dialogue that demands inclusivity of multiple viewpoints. Scholarship anticipating the future of education existed prior to the pandemic as well. Creighton-Offord (2017) for example, describes a dystopian future in which students and professors became disconnected and algorithmic, a future in which lonely students roamed digital spaces collectively wondering whether their professor was ever human.

While such speculative writing speaks to what likelihood futures may look like, it also offers insights about the present (Facer, 2011). Zimmerman’s story points to current concerns around political polarization. Crighton-Offord’s story suggests that technology diminishes important human aspects of the learning experience. Motivated by the recognition that what scholars imagine might unfold in the years and decades to come reflect issues faculty are observing and experiencing in the present, this study sought to identify the hopes and anxieties that Canadian faculty are facing in late 2021 as they consider what higher education may look like five years into the future (hereafter referred to as the near-future of higher education). Our objective was to generate an in-depth understanding of hopes and anxieties during a period of uncertainty and reflection, and identify challenges that higher education faculty perceive as impacting the future of the sector. To do so, we conducted one-to-one interviews with 37 faculty and analyzed the data collected using a constant comparative approach. We begin with

a review of literature relevant to the future of higher education, followed by an overview of the theoretical framework that was used to analyze the data. We then present and discuss our findings and their implications.

## Review of the Relevant Literature

The study of benefits, drawbacks, potential roles, and impacts of technological advancements in higher education have long been topics of interest and debate amongst academics. To name a few, such topics have included everything from artificial intelligence to digitalization, future learning paradigms, globalization, marketization, microcredentials, and workforce skills development (Aoun, 2017; Cormier et al, 2019; Facer, 2011; Future Skills Council, 2020; Macdonald, 2019; Macgilchrist et al., 2020; Selwyn et al., 2020). Intertwined with scholarship examining the role of technology in the future of education are discussions about the ways in which social, political, cultural, and economic forces are shaping higher education (Barber et al., 2020; Brown et al., 2020; Siemens & Matheos, 2010; Tierney, 2020). The relationships between higher education and these forces are complex and Facer (2011, p. 14) urges researchers and practitioners "to rewrite the relationship between education, socio-technical change and the future if we are to ensure that socio-technical changes of the next two decades do not simply serve to produce futures of profound inequality and environmental degradation.".

The COVID-19 pandemic further complicated and shaped conversations about the future of higher education. A number of researchers have explored the direct impacts of the rapid transition to emergency remote teaching, describing in detail the unprecedented and challenging circumstances faculty, staff, students, and administrators faced during the pandemic (Belikov et al., 2021; Claubaugh et al., 2021; Houlden & Veletsianos, 2022; Johnson et al., 2020; Littlejohn et al., 2021; Oliveira et al., 2021; VanLeeuwen et al., 2021). Administrators, instructors, and students, alike, had to quickly adjust to near-constant technology use while managing the anxiety, stress, isolation, and unpredictability of the pandemic. Other scholars have ruminated on the long-lasting impact of the pandemic (Grove et al., 2020). For example, Costello et al. (2020) used a speculative approach that places the reader in the year 2050, reflecting on the pandemic as a critical moment in history and provoking the reader to consider a dystopian future that could conceivably come to pass with the pandemic being the final catalyst leading to a post-truth, post-human era. Lockee (2021) is more optimistic, at least in the positive role that technology may have on education. She sees the pandemic as a pivotal moment and anticipates that it will permanently alter pedagogical practices and the delivery of education particularly in terms of increasing online and hybrid learning options.

The future of post-secondary education as impacted by ongoing challenges such as the COVID-19 pandemic remains a heated topic of discussion. Peters et al. (2020) and Wyatt-Smith et al. (2021) for instance each compiled the perspectives of faculty, who expressed concerns and highlighted opportunities for change as the pandemic abates. Respondents emphasized concerns about neoliberalism, climate change, the political landscape, the economy, technology, and the intertwined nature of these concerns with the pandemic. They also noted the importance of refocusing on well-

rounded, interdisciplinary educational practices and moving away from a business-model style of post-secondary governance. In their essay on the implications of widespread technology adoption, Teräs et al. (2020) argued for the importance of reflective action with consideration to the long-term impacts of the choices made during the COVID-19 pandemic. They posited that technological solutions are not neutral and have the potential to reinforce and exacerbate existing problems if they are implemented without first scrutinizing, and perhaps rethinking, the objectives of higher education. In a report released by Georgetown University (2021), academics and administrators in the United States highlighted how the disruption brought about by the COVID-19 pandemic has cast a spotlight on existing inequities and has created openings for meaningful systemic changes, which is a topic highlighted in a number of other studies (Harper, 2020; Jaggars et al., 2021).

An overwhelming amount of gray literature focusing on the future of higher education also exists. Much of this is opinion-based and overshadows the limited literature that is grounded on systematic analyses of student, staff, faculty, or administrator perspectives. Watermeyer et al. (2020) note that there is a need for research, rather than opinion, which explores the near future of higher education in order to identify the prospective impacts of the pandemic, particularly the subsequent (and likely inevitable) digital transformation of teaching and learning. In their survey of nearly 1,200 faculty in the United Kingdom, in which they asked respondents about the shorter-term impact of the shift to online instruction as a result of the pandemic, they find that respondents anticipate an increased workload over the next three years and are concerned about the impact of digitization and marketization, the scope of their role (such as having to support student mental health without adequate qualifications), and increasing precarity for adjunct and casual academic staff. Systematic studies of faculty perspectives are necessary and important because they highlight the experiences and expectations of individuals who are "on the ground" and who see the future of education through an insider perspective.

The purpose of this study therefore is to add to the aforementioned literature by identifying faculty hopes and anxieties about the near-future of higher education. Our previous work, conducted during the early months of the pandemic, showed that even though Canadian faculty faced significant challenges (Belikov et al., 2021; VanLeeuwen et al., 2021), faculty respondents were also almost evenly split as being either optimistic or pessimistic about the future of higher education (Veletsianos et al., 2020). These exploratory investigations provided the basis for the systematic effort that we provide here. In engaging in this research, we respond to the urgent need identified by Watermeyer et al. (2020, p. 624) to "map the terrain" of change and transformation in the higher education sector.

## Theoretical Framework

We theorize *hope* using key dimensions of the concept identified in the Herth Hope Index, the Synder State Hope Scale, and the Multidimensional Hope in Counseling and Psychotherapy Scale (Arnau, 2018; Larsen et al., 2020; Schrank et al., 2008). To theorize *anxiety*, we use Barlow's (2000) concept of anxious apprehension. While much of the literature theorizing hope and anxiety is clinical

(e.g., counseling, psychiatry, psychology, psychotherapy), the operationalization of these two concepts in the literature is broad enough to inform this research.

Hope is a positive concept and "a primarily future-orientated expectation" (Schrank et al., 2008, p. 426). Models of hope consistently include five dimensions: cognitive, affective, behavioural, relational, and environmental. The cognitive dimension of hope focuses on an awareness of different possibilities within a situation, whether the desired outcome is probable or realistic, and one's ability to develop goals and strategies to achieve desired outcomes (Arnau, 2018; Larsen et al., 2020). The affective dimension relates to the presence of positive emotions such as trust and confidence (Schrank et al., 2008). The behavioural dimension consists of mobilization and taking action toward one's goals (Larsen et al., 2020). The relational dimension is comprised of supportive and spiritual relationships that provide a sense of interconnectedness with others (Arnau, 2018; Larsen et al., 2020); and the environmental dimension encompasses the availability of resources to the individual (Schrank et al., 2008). This understanding has a variety of implications for our study, for instance, that hope is impacted both by an individual's cognitive processes as well as their relationships and context.

In making sense of anxiety, Arnau (2018) distinguished between panic-related anxiety (fear) and *anxious apprehension (hopelessness)*. Panic-related anxiety, or fear, is oriented in the present and triggered by an immediate threat. For the purposes of this paper, we turned to anxious apprehension, which is oriented toward the future and is triggered by the perception that one is unable to prevent a negative or undesirable outcome (Barlow, 2000). Like hope, anxious apprehension therefore orients itself toward the future. The presence of anxious apprehension indicates a perceived lack of possible positive outcomes, positive emotion, control, support, or resources that negatively impact one's overall sense of hope.

## Methods

We posed the following research question: What hopes and anxieties do faculty members in Canada have about the near future of higher education?

### Participants

We recruited participants through social media and email outreach. A call for Canadian faculty willing to participate in a 45-minute interview was shared as (a) an advertisement emailed to faculty subscribed to updates from one of the largest research and institutional consulting firms in Canada, and (b) social media posts on the Twitter and Facebook profiles of authors, tagged with hashtags relevant to the higher education sector in Canada. These calls were subsequently shared by others via typical Internet affordances (e.g., retweeting, emails shared amongst colleagues, etc.). Potential participants clicked on a link that directed them to a consent form which included information about the study. Consenting individuals were asked for their contact email and were presented with a demographic questionnaire. Thereafter, researchers purposefully selected who to interview in an iterative manner in order to capture a diverse range of perspectives, seeking to include a wide range of ages, disciplines,

positions, institutional locations, and types of institutions. Interviews continued until researchers felt that saturation had been reached, which was the point at which the last set of three interviews conducted added little new insights to the data. At that point, the data collected was already extensive, rich, and well beyond common recommendations in the literature (Baker & Edwards, 2012). The thirty-seven individuals that were interviewed for the study are listed in Table 1. All were older than 35 years of age, distributed evenly across the age ranges of 55+ (13), 45-54 (12), and 35-44 (12). They held positions in universities (23) and colleges (14). Most held doctorates (21) and master's degrees (14) while two held bachelor's degrees. In terms of rank, interviewees consisted of full professors (15), associate professors (8), and assistant professors (7). Four were sessional (adjunct) instructors and four identified as holding permanent full-time positions (three full-time faculty, one full-time researcher). Their institutions were located in Ontario (23), Alberta (5), British Columbia (2), Manitoba (2), New Brunswick (2), Northwest Territories (2), and Prince Edward Island (1). Their disciplines were Social Sciences (11), Healthcare (8), Education (6), Arts (4), Business (3), Science (3), Culinary Arts (1), and Political Science (1).

**Table 1**

*Participant Demographic Information*

| Name or Pseudonym* | Age | Degree | Discipline | Position | Province or Territory | Type of institution |
|---|---|---|---|---|---|---|
| Don | 55+ | Doctoral | Political Science | Full professor | PEI | University |
| Charanjit | 55+ | Master's | Education | Permanent full-time | Ontario | College |
| Laura* | 55+ | Master's | Healthcare | Permanent full-time | New Brunswick | College |
| Riley | 35-44 | Master's | Culinary Arts | Full professor | Ontario | College |
| Gary | 55+ | Bachelor's | Business | Sessional faculty | Ontario | University |
| Melanie | 45-54 | Master's | Business | Full professor | Ontario | College |
| Elizabeth* | 35-44 | Master's | Arts | Full professor | Ontario | College |
| Kaleb* | 45-54 | Master's | Social Sciences | Full professor | Ontario | College |
| Joy* | 55+ | Master's | Healthcare | Permanent full-time | Ontario | College |
| Julian | 55+ | Master's | Healthcare | Full professor | Ontario | College |
| Heather* | 45-54 | Master's | Social Sciences | Full professor | Ontario | College |

| Name or Pseudonym* | Age | Degree | Discipline | Position | Province or Territory | Type of institution |
|---|---|---|---|---|---|---|
| Jan | 55+ | Master's | Arts | Full professor | Ontario | College |
| Alice* | 55+ | Master's | Healthcare | Associate professor | Manitoba | University |
| Nicole | 55+ | Bachelor's | Education | Full professor | Ontario | College |
| Dawn* | 55+ | Doctoral | Education | Permanent full-time | Northwest Territories | College |
| Sharlene* | 55+ | Doctoral | Education | Associate professor | Alberta | University |
| Erin* | 35-44 | Master's | Business | Sessional faculty | Ontario | University |
| Alan* | 45-54 | Doctoral | Science | Full professor | Ontario | University |
| Denay* | 35-44 | Doctoral | Social Sciences | Associate professor | Ontario | University |
| Sarah* | 35-44 | Doctoral | Social Sciences | Assistant professor | Alberta | University |
| Kelly | 45-54 | Doctoral | Social Sciences | Sessional faculty | Ontario | University |
| Micah* | 45-54 | Master's | Arts | Full professor | Ontario | College |
| Jim | 55+ | Master's | Education | Sessional faculty | Northwest Territories | College |
| Theo* | 45-54 | Doctoral | Social Sciences | Full professor | Ontario | University |
| John* | 45-54 | Doctoral | Social Sciences | Full professor | Ontario | University |
| Rebecca* | 45-54 | Doctoral | Social Sciences | Associate professor | Ontario | University |
| Tanya | 35-44 | Doctoral | Education | Associate professor | Ontario | University |
| Taylor* | 45-54 | Doctoral | Healthcare | Assistant professor | Alberta | University |
| Mary* | 55+ | Doctoral | Healthcare | Full professor | Alberta | University |
| Jeremiah* | 45-54 | Doctoral | Social Sciences | Associate professor | Ontario | University |
| Dave* | 35-44 | Doctoral | Social Sciences | Assistant professor | Ontario | University |
| Lisa* | 35-44 | Doctoral | Arts | Assistant professor | Alberta | University |

| Name or Pseudonym* | Age | Degree | Discipline | Position | Province or Territory | Type of institution |
|---|---|---|---|---|---|---|
| Jay* | 35-44 | Doctoral | Science | Assistant professor | British Columbia | University |
| Grace* | 35-44 | Doctoral | Healthcare | Assistant professor | British Columbia | University |
| Caroline* | 45-54 | Doctoral | Science | Full professor | New Brunswick | University |
| Janine* | 35-44 | Doctoral | Healthcare | Associate professor | Ontario | University |
| Jocelyn* | 35-44 | Doctoral | Social Sciences | Associate professor | Manitoba | University |

*Note.* An * indicates a pseudonym. The rest of the participants preferred to be identified by name.

**Data Collection**

Participants were interviewed using a video-conferencing application, and data were collected through a semi-structured interview protocol (Appendix 1). The interview consisted of broad open-ended questions focused on faculty hopes and anxieties about the future of higher education within their own institution and at the national level. Interviews lasted between 30 and 40 minutes and were audio recorded. They were then transcribed verbatim using an automated speech-to-text transcription software. Each interview was then read and revised for accuracy prior to analysis.

**Data Analysis**

A constant comparative approach was used to analyze the data (Glaser & Strauss, 1967). The two researchers read through all the transcripts to gain an overall understanding of the data. They each read each transcript independently and created a list of early codes identifying hopes and anxieties. The two researchers then discussed these codes, merged them into a single codebook, defined each code, and discussed potential themes. Next, one researcher coded the data in an iterative manner. Using the initial codebook, they read each transcript, and assigned codes to the text. The researcher read each sentence and paragraph in a transcript and compared it to the codebook. If the sentence and/or paragraph was defined by an existing code, it was coded as such. If the sentence and/or paragraph required a new code, the researcher created a new code, defined the code, added the code to the codebook, and tagged the relevant text with the code. Whenever a new code was added to the codebook, the researcher reviewed the previously coded transcripts to check whether any data should be assigned to the newly generated codes. Eventually, the process of constantly comparing the transcripts to the codes resulted in a list of codes describing all the data. Throughout the analysis, the two researchers met regularly to discuss and revise the existing and emerging codes, and to explore and identify any preliminary patterns. After several rounds of discussion, and after the researchers felt the

data had reached saturation, the codes were arranged into themes using the conceptual models of hope and anxieties described above.

### Credibility and Trustworthiness

Multiple steps were taken to minimize the incidence of bias in the analyses. First, we employed investigator triangulation by independently reviewing transcripts prior to discussion of initial codes to avoid influencing one another's understanding of the data. Second, we examined the demographic information of all potential participants, and purposefully selected who to interview incrementally so as to interview as wide and diverse a sample as possible. Third, we continued adding participants to our dataset until the data we had gathered were both rich and considerable. Fourth, we continued analyzing data until we felt that we reached thematic saturation. Fifth, we presented findings using thick descriptions to help readers establish whether the results apply to their own contexts (Merriam, 1995). Finally, we conducted member checks by emailing participants a summary of findings to verify that those accurately represented their experiences. Of the 37 participants interviewed, 15 responded to our emails, and they all affirmed that the findings captured their experiences.

### Limitations and Delimitations

A key limitation to our study is the diversity of the individuals interviewed. Those who responded to the call for participation were primarily full-time faculty of Caucasian descent, most of whom reside and work in Ontario. While Ontario is the most populous region with the most public institutions in Canada, our sample of participants risks over-emphasizing the perceptions of Ontario-based faculty, especially due to the fact that higher education in Canada is a provincial/territorial vis-a-vis federal responsibility. As an internal check of our data, we compared responses between this group and the group of participants who were adjunct, or from provinces other than Ontario, and we found that the two groups reported similar hopes and anxieties, thus strengthening confidence in our results. We were unsuccessful in recruiting participants from all provinces/territories, most notably Quebec, and while some participants identified as Black, Indigenous or People of Color, we acknowledge that our sample lacks ethnolinguistic diversity which may impact the results.

## Results

We identified four themes, and these are listed in Table 2 along with the number of participants who made comments that related to each theme.

**Table 2**

*Themes and Number of Faculty Members Represented in Each Theme*

| Theme | Number of Faculty |
|---|---|
| Supports and resources from various sources shape hopes and anxieties | 36 |
| Anxiety over matters that negatively impact faculty but are beyond their control | 34 |
| Faculty hope that good comes from the pandemic | 32 |
| Faculty hope for a well-rounded education will enable students to succeed both within and beyond their careers | 35 |

## Supports and Resources From Various Sources Shape Hopes and Anxieties

Nearly all participants expressed their hope that they will be supported in achieving desired outcomes. Such support took the form of both resources and relationships, and faculty spoke about support from specific sources that they hoped would become available or increase in the future. They also shared their apprehension about the likelihood that supports would diminish, disappear, or not come to fruition. We identified three specific sources of support: government, institutional, and societal. In general, we found that faculty hope for greater societal recognition of the value of higher education to the extent that governments will be compelled to place a priority on funding Canadian post-secondary institutions. In turn, many faculty expressed hope that increased funding will make higher education more accessible and reduce pressure to cut programs. Concerns typically centered on the fear that these hopes will not come to fruition, and the negative consequences that will arise as a result.

### *Government Support (31 Participants)*

While participants described their hopes that students and higher education, in general, would receive greater government funding in the future, they also were concerned that such funding would not materialize. Twelve faculty expressed hope for reductions in tuition costs for students to improve accessibility. For example, Denay said: “I hope that the costs of higher education would be lowered for students so that tuition is not a lifelong thing that they have to take on. That’s very problematic. And so I would hope to see lower tuition or tuition-free education. I think that would be fantastic.” Others made similar remarks. Heather expressed her hope for better financial support for students such that “marginalized populations can access higher education so that we have more diversity in certain sectors.” While optimistic, some faculty expressed caution. Nicole for instance, mentioned that she was hopeful for tuition-free funding to exist in Canada similar to what she has observed in European countries but noted: “I don't expect we'll ever get there, especially not in five years, but it would be

really nice. I would hope that we could reduce those [financial] barriers." Similarly, Caroline's "sincerest hope" and "fondest goal" was for "post-secondary, - whether it's a community college, polytechnic, university, whatever - to be made free…[which in turn] would alleviate some of the financial issues" that students and youth are facing.

Seven faculty reported being worried that the political climate in their province would lead to increased costs of post-secondary education in the near future, thus reducing the financial support that students receive. Jocelyn remarked that she hoped for higher education to be affordable for students, but was concerned over the negative impact that government decisions could potentially have on affordability. She said:

> Especially with some of the changes that our provincial government is looking to make, it is going to make [higher education] more unaffordable, make certain programs more unaffordable. Because part of what they're trying to do with the legislation is give themselves the power, instead of the universities, to set tuition rates, leading to tuition being lower for some programs, prioritized programs, the job-ready programs that the government considers valuable. So certainly, you know, I hope it's affordable for all students, and that it's accessible to students from traditionally underrepresented groups in academic programs.

***Institutional Support (31 Participants)***

At the institutional level, faculty concerns about support centred around workload, adjunctification, increasing class sizes, program cuts, and the policy and strategy decisions being made by institutional leaders. In the early stages of our interviews for this study, Laurentian University in Ontario declared insolvency along with major program cuts, making national news. Roughly half of participants alluded to the situation at Laurentian in discussing their anxieties. Many faculty reported that they received less support from their institutions over time and worried that such support would continue to diminish. Kaleb stated, "My fears are that we will continue to be underfunded, and administrators will be making cuts in areas that we as academics think are vital for the work we do." Theo noted that continual increases in workload are going to negatively impact the quality of the student experience.

Nineteen faculty reported concerns about adjunctification and a lack of institutional support for continuing full-time or tenure-track models of faculty employment. The worry that support for full-time staff would continue to decline was linked to the perception that the institution was acting more like a corporation with a focus on the financial bottom line instead of the well-being of students and faculty. Julian stated, "I keep coming back to money, which is really sad because that's not what I believe we're all about. But I believe that there's more and more demand for accountability, there's greater competitiveness for funding, and there's less funding going out to higher education. And so they're looking at ways of staying financially responsible and accountable."

Ten faculty members expressed nervousness that corporatization within their own institution would lead to program cuts that would limit the educational options available to students, especially

certain kinds of programs. Don remarked that the perception among administrators appeared to be that "the humanities courses are the frosting on the cake, the extras. Make things pretty, but they're not essential to the mission." He continued, "I'm afraid [administrators] are not going to see what steps need to be taken to ensure that [humanities are protected] because to me if they're not there, the whole point of the university is lost. That would be my concern." The source of anxiety in most instances appeared to be a lack of government support combined with a corporate mindset among administrators, leading faculty to wonder whether their own institution would some day in the future find itself in a financial crisis. Laurentian's declaration of insolvency seemed to aggravate these concerns. Janine wondered, "Will we have universities, small universities, community-based universities at all in 2026? I never thought I'd be saying this but with what happened with Laurentian, I do have questions about that . . . a year ago, this never would have crossed my mind, I never would have felt this uncomfortable, this scared, this anxious. But here we are."

### *Societal Support (16 Participants)*

A sense of waning support for higher education from the general public was a further source of anxiety for faculty. Kelly described the current state of public support as "discouraging and disheartening" but added that she hadn't given up hope. She continued, "You need public support for establishing a robust university system. And I think actually, we're going to a weird intellectual place right now with, you know, the rise of right-wing populism . . . I've seen some disturbing talk online about how universities are just outdated and they're brainwashing institutions and all that… that kind of stuff I find very discouraging." Joy commented that she has observed "anti-teacher stereotypes out there at all different levels" and that "the public misunderstands what it is that we as faculty are trying to do." Janine expressed concern that the current culture of "anti-intellectualism" would lead to less money being put toward higher education "given that there's not as much of a perceived value of higher education within our society anymore."

## Anxiety Over Matters That Negatively Impact Faculty, But Are Beyond Their Control

Faculty identified issues that were outside of their control as sources of anxious apprehension. When they described factors that contributed to their concerns, they tended to position both problems and solutions as being in the hands of others such as 'universities,' 'senior administration,' 'business leaders,' and 'the government.' These groups were described as having power and control over the working conditions of faculty, highlighting tensions between personal agency and institutional control. For example, John and Jocelyn expressed their fears around pressures for commodification, and Lisa said, "Our government is going to try and push us towards a more American-style of privatization or [creating] public-private partnerships for institutions like ours."

Participant remarks carried an underlying tone of hopelessness and several faculty shared their anxiety of negative repercussions that might arise if they attempt to oppose undesirable changes. Janine remarked, "It just is becoming increasingly problematic with increasing tensions between senior administration and faculty where faculty rights and collective bargaining processes are not necessarily respected, and this can create some hard feelings in the long- and short-term." She added that these

tensions were a result of "running universities like a business and seeing faculty as the problem rather than the solution." Jocelyn shared her concern that the situation with Laurentian University declaring insolvency would set a precedent, a "blueprint for governments who want to get around those exigency clauses in the collective agreements." As for the possible consequences to faculty, Sarah said, "I am afraid that universities are going to be run like corporate, neoliberal, standardized test systems where a lot of the important labour the faculty do is outsourced or automated."

Anxiety about lack of control over outcomes extended beyond the institution. Some faculty described what they felt as a decreasing influence of their role as educators on the broader culture, which is pushing for changes that are incompatible with quality education. The sense of cultural priorities overriding educational priorities mostly emerged in comments relating to increasing attitudes of neoliberalism and anti-intellectualism. For instance, John expressed concerns about "the McDonaldization approach to education," which he attributed to a growing sense of belief around education as a product for purchase. Tanya, Jim, Dave, and Sharlene also described negative changes being driven by neoliberalism and anti-intellectualism within Canadian culture. Tanya said that she worried about "anti-education sentiments and a neoliberal attitude of buying an education" increasing over time. Jim noted his concerns that government funding may be redirected to "producing entry-level workers for industry" due to "the increasing populist politics and neoliberal economics." In a moment of self-reflection, Sharlene asked: "Why is that? Where have we missed the boat [in the post-secondary sector] to be able to demonstrate our value to our citizens?"

The unfamiliar terrain that higher education is currently navigating, as well as faculty members' perceived inability and lack of control to influence institutional direction, aggravated the unease that faculty were feeling. For instance, Riley noted that while "changes are going to have to happen, we can't control when they do happen and that creates a little bit of anxiety." Janine described feeling like "everything is up in the air right now," adding, "which is probably where some of my anxiety comes from, as well as not actually knowing in five years from now, what this [higher education] is going to look like for us." Lisa echoed these sentiments, noting that she can no longer "foresee what the world will look like in 10 years… I think that has gone for me, at least it's gone down… and that is causing anxiety." Jeremiah described feeling very troubled because at his institution faculty "have absolutely no control over what is happening to us," and Denay described "feeling like we're kind of in the dark about why we're doing certain things in the first place." Theo painted a starker picture when he said: "Our institution lacks so much direction that nobody knows what our goals are or what we want to become."

### Faculty Hope That Good Comes From the Pandemic

While participants often noted that the pandemic itself was challenging, and exacerbating their anxieties, many highlighted that they hope that something positive will come out of these circumstances. For example, eleven faculty stated that the pandemic provided varied opportunities for learning and change that gave them a sense of hope. John captured this by stating: "As much as the pandemic is a horrible, horrible, horrible thing to live through, it gives all sectors of society a unique opportunity to identify areas for change, and then to make that change happen. And education is

definitely one of those areas." In reflecting on the changes since the start of the pandemic, Erin stated, "It's remarkable how dramatically we've changed what we do. It's made me more hopeful for the future to think that we can change that quickly and that dramatically." Similarly, Kelly described feeling hopeful that "change can happen and happen quickly, and that we are adaptable" and Sharlene said that when she "think[s] ahead five years, [she] hope[s] that learnings are carried forward into that time."

The positive outcomes that faculty hoped would be sparked by the pandemic included fresh and innovative approaches to pedagogy, greater collaboration, the emergence of new learning options, and "changes in structures, focus, and priorities" (Mary). Several participants, for instance, noted how the rapid shift to remote courses compelled faculty to change their teaching practices. Jay was hopeful for positive "rippling consequences" resulting from the switch to online modes to teaching and learning. Rebecca noted that the pandemic "has raised important questions about pedagogy that maybe we weren't talking about before . . . I think it's been a really painful experience but, hopefully, it has prompted us to think about teaching in helpful ways." John described feeling hopeful that the pandemic would "push a vision of change in how we deliver educational opportunities for students in post-secondary institutions," and expressed his hope that several decades from now,

> people who are still alive can look back and go, 'yeah, that was a really bad time in world history, but look at all these amazing things that came out of it.' With respect to university education, look at all these changes that were made. Look at all these lasting differences that we see. And I'm hopeful that that's what happens.

The hope for the emergence of new learning options was shared by five participants. For example, Rebecca, Charanjit, Don, and Erin expressed hope that online learning options would remain and offer more flexibility for faculty and students going forward. Charanjit remarked that the pandemic accelerated technology adoption by encouraging faculty to learn how to use new technologies. Don hoped for a breakdown in disciplinary silos, and Erin hoped that "there could be more opportunities for people like me [adjunct faculty] in academia as a result of a move to more of these smaller credentialing type programs or courses." Mary spoke about a more hopeful future that addresses systemic inequities, Alan shared his wish that "everyone will be a bit more patient," and Melanie expressed her desire that "some of the compassion and flexibility that we have been required to quickly ramp up the past year" would be maintained.

### Faculty Hope For a Well-Rounded Education That Will Enable Students to Succeed Both Within and Beyond Their Careers

Participants expressed their desire that in the future students would leave post-secondary education with both the skills necessary to enjoy a successful career, as well as the critical thinking skills necessary for a well-rounded knowledge base that would enable them to become thoughtful members of society. The primary reason that faculty expressed these hopes were due to concerns they had about students' futures: nine participants were concerned that post-secondary education seems increasingly unlikely to enable individuals to improve their economic prospects; seventeen expressed

concerns about the quality of higher education that students are receiving with respect to job preparation; and four noted concerns about sufficient job opportunities for graduate-level students. These concerns prompted participants to describe their hopes for the role of education in students' lives, and nearly all of them noted that they hoped higher education enables economic prosperity in addition to personal and societal growth. Sixteen participants described their hope that such an education includes critical thinking skills, soft skills, and interdisciplinary learning experiences.

To facilitate the development of critical thinking skills, Alice, Taylor, Jay, Jeremiah, and Elizabeth expressed the hope that higher education would become less focused on grades and more focused on creative problem-solving. Taylor expressed her wish that greater emphasis would be placed on the learning process, particularly on gaining and applying knowledge. Jay echoed Taylor's sentiments saying he hoped to see learning environments that helped students "understand that it's okay to be wrong and that how they respond to being wrong is the most important aspect." He added, "I think students are too afraid to be wrong because we focus too much on the right answer and not the process." Alice and Elizabeth noted that the critical thinking skills resulting from well-rounded educational experiences would lead to positive student outcomes that extended beyond work. Alice said, "My dream would be that personal development is as much of a priority as attaining whatever the degree is and whatever the job is . . . the value of a liberal arts education is just being a more interesting, broad thinking person and challenging the status quo and asking good questions and engaging in debate. I would love to see that element come back to post-secondary education." Elizabeth also described hoping to see a swing back toward valuing this kind of education, saying, "I want my students to be thinking beyond their job…I want them to be thinking about just their life and where they can be thinking deeply and engaging with the world, whatever they are doing."

Further to the impact of well-rounded education experiences beyond students' careers, Denay and Sharlene spoke to their hope that it would positively impact society. Denay noted, "My hopes for higher education are to maintain systems of education that provide a broad base of education for students and that we don't lose the breadth of topics that students can learn about. I hope [higher education] maintains the richness and variety of topics that I feel benefit students, benefit our society, and benefit Canadians." Sharlene remarked, "I think that post-secondary can also hold the key for some of the solutions to the problems that we're having to deal with. And I hope that we can play a strong key role in helping address some of the issues we see in society and continue to build a strong workforce and a scholarly workforce that's able to lead us well into the future."

## Discussion and Implications

The existing literature highlights that the COVID-19 pandemic represents a critical juncture in higher education (Costello et al., 2020; Lockee, 2021), often framed in terms of a "new normal." The hopes and anxieties identified in this paper reiterate the expectation that the pandemic may have significant impacts on the future of higher education.

Similar to the perspectives compiled by Peters et al. (2020) and Wyatt-Smith et al. (2021), the systematic analysis presented here identifies anxieties focusing on neoliberalism, the political landscape, technology, and the intersection of these themes with pandemic-related concerns. Hope theory is helpful here in making sense of faculty aspirations about better futures. In the *cognitive* dimension, faculty appear to explore different possibilities to address the current circumstances they find themselves in and explore whether a desired outcome is realistic (Arnau, 2018; Larsen et al., 2020). The presence of positive emotions such as trust and confidence are central in the *affective* dimension of hope (Schrank, 2020). The belief that government or institutional leaders have the power and resources to implement new policies that would result in positive change (e.g., Nicole noted that she felt tuition-free higher education was realistic based on what she had observed in European nations) is a major driver of hope for faculty. However, the data also reveal a general absence of trust that government officials and institutional leaders would be able to develop policies to improve higher education, highlighting *relational* and *environmental* dimensions of hope. *Behavioural* dimensions of hope (i.e., one's ability to take action to achieve a goal or outcome (Larsen et al., 2020)), also figured prominently in the data. Some participants described decisions made at the government and institutional levels as being imposed upon them with little opportunity to voice their concerns or oppose such changes. When faculty described absence of feelings of personal agency, characterized by the sense that effecting change was outside their locus of control, they also described feelings of anxious apprehension.

A few participants noted that one of the major lasting impacts of the pandemic would be increased digital learning. Faculty hoped that increased digital learning would lead to more flexible learning options, improved pedagogical practices, and greater accessibility for students. However, some also feared that digital learning would be used to increase class sizes, automate aspects of the learning experience, and result in lower quality offerings. Faculty anxieties in this area were not necessarily rooted in the pedagogical potential of digital learning or the power of the technology, but rather on a lack of confidence that institutional and government policy-makers would prioritize sound pedagogy and quality learning experiences in their decision making. One of the key findings from our research is the perception of distrust among faculty toward institutional leaders and government policy-makers in navigating current circumstances and leading the sector into more hopeful futures. As digital learning opportunities continue to expand, and given the extensive literature that already exists around the efficacy of online learning (Castro & Tumibay, 2021), it would be worthwhile to expand the contours of research in this area. While research on pedagogical strategies and technology integration methods continues, it is also necessary to investigate the ways in which individuals in the higher education system (e.g., faculty, administrators, students, instructional designers, government officials, etc.) can engage in productive and collaborative efforts to develop learning and teaching futures that are grounded in hope and cooperation. Faculty in our study for instance hoped for more opportunities to communicate and collaborate with leaders at their institution. Future research could examine instances in which such collaborations were fruitful and offer strategies for engaging in such efforts, for both faculty and academic leaders.

At a cognitive and environmental level, faculty hoped for greater funding but they did not have confidence that the current governments would provide what they perceived to be adequate funding for the delivery of high quality and equitable learning experiences. The trend toward corporatization and students-as-customers within the post-secondary system repeatedly emerged as a concern. Faculty were concerned that institutions were failing to act in a responsible manner and were concerned that future-oriented decisions at a time of reduced funding would lead to less resources, curtailment of faculty positions, further precarity, and learning experiences of lower quality. While these concerns are neither new nor original, they have gained increasing importance during the pandemic for study participants. Future research could investigate the degree to which these concerns are prevalent in Canada and in other contexts.

Finally, multiple participants expressed their belief that the general public places significantly less value in higher education as a benefit to society than in the past. Faculty did not trust the government or institutional administrators to take initiatives to challenge or oppose what they perceive to be problematic societal values, nor did they perceive themselves as having the power to change the status quo. Of utmost concern was a prevailing sense of anti-intellectualism leading faculty to fear for greater long-term impacts on institutions and society. Future research in this area could take many directions, such as for instance probing the ways in which this belief impacts pedagogical practices and outcomes.

## Conclusion

In this study, faculty hopes for the future appear to be grounded in what they believe to be possible within the realm of their control. Their anxieties seem to be rooted in a lack of confidence that others will take necessary action to bring these hopes to fruition. Further, participants appear to perceive themselves as lacking the agency and ability to influence change. While faculty do not appear to expect that they will encounter overly utopian or dystopian futures in the short-term, they seem to expect a progressive erosion of quality resulting from neoliberal practices anticipated to have long-lasting impacts on institutions of higher education. Nevertheless, faculty rarely described hopeful alternatives in specific or detailed ways. The research that we believe is imperative and urgent, and that we encourage the scholarly community to explore, invites us to ask: What are hopeful futures for higher education? What do those look like, what should they look like, and why? And how may faculty, in partnership with others - students, administrators, governments, communities - bring them to fruition?

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## Appendix 1

## Semi-Structured Interview Protocol

**Q1:** What are your hopes for higher education in the year 2026?

**Q2:** Do you have any fears or anxieties surrounding higher education in the year 2026?

**Q3:** What changes do you anticipate taking place at your own institution by the year 2026?

**Q4:** How has the pandemic impacted your outlook of higher education in Canada?

**Q5:** For my last question, I was hoping to ask you to take your crystal ball and imagine that you are teaching a course at your institution in 2026. Could you please describe to me a typical day at work? What happens? What do you think life is like?

**Q6:** Thank you very much. Is there anything else that you'd like me to know before we end this interview about the future of higher education and how you hope or fear it will turn out?

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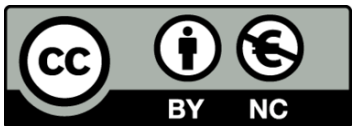

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# Utilité des fonctions d'aide technologique sur les performances en lecture et en écriture et sur le concept de soi scolaire auprès d'élèves du primaire qui ont des difficultés d'apprentissage

# Usefulness of Assistive Technologies for Reading and Writing Skills and Academic Self-Concept for French-Speaking Elementary Students with Learning Difficulties

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**Résumé**

Cette étude pilote porte sur l'utilisation des fonctions d'aide technologique (FAT) par des élèves du primaire, scolarisés en français et ayant des difficultés en lecture et en écriture (groupe FAT, $n = 25$). L'objectif est d'évaluer si les FAT améliorent leur compréhension de lecture et leur concept de soi scolaire (CSS) et si elles permettent de réduire le nombre de fautes à l'écrit. Un groupe de comparaison d'élèves tout-venant ($n = 22$) est inclus pour examiner si les scores des deux groupes se rapprochent au fil du temps. Les résultats montrent qu'après seulement cinq mois d'utilisation des FAT les élèves du groupe FAT réduisent leurs fautes à l'écrit et ils obtiennent même des performances comparables à celles de leurs pairs tout-venant. Pour la compréhension de lecture et le CSS, les effets d'interaction ne sont pas significatifs. Les implications pour la réussite scolaire et les recherches futures sont discutées.

*Mots-clés* : difficultés en lecture et en écriture ; fonction d'aide technologique ; concept de soi scolaire

**Abstract**

This pilot study focuses on the use of assistive technologies (AT) by elementary school students, educated in French, who were identified with reading and writing difficulties (AT group, $n = 25$). The aim of this study is to assess whether assistive technologies improved their reading comprehension, spelling errors, and academic self-concept. A comparison group of average achieving peers ($n = 22$) is included to examine whether the gap in scores of the two groups is reduced over time.

The results show that between the two time periods, students in the AT group reduce their spelling errors, and after just five months using assistive technologies, they even got comparable performances to their normally achieving peers. In reading comprehension and academic self-concept, the interaction effects are not significant. The implications for academic success and future research are discussed.

*Keywords*: Reading and writing difficulties; Assistive technology; Academic self-concept

## Introduction

La lecture et l'écriture sont omniprésentes dans le parcours scolaire des élèves. Ceux qui ont des difficultés à lire ou à écrire sont donc à risque d'échecs multiples (Hakkarainen et al., 2015) ou de décrochage scolaire (Ducharme et al., 2018). De telles difficultés peuvent être transitoires ou persistantes (Guay, 2019). Pour favoriser l'apprentissage de la lecture et de l'écriture, plusieurs services de rééducation sont offerts en milieu scolaire. Toutefois, si les difficultés persistent malgré tout, des mesures de compensation comme les *fonctions d'aide technologique* (FAT) sont proposées à l'élève (Chouinard, 2016). Il s'agit d'une assistance technologique sans laquelle les tâches scolaires seraient difficiles ou impossibles à réaliser (Ministère de l'Éducation du Loisir et du Sport, 2011). L'octroi de telles mesures de compensation découle du principe d'*inclusion scolaire*, dont le but est d'accueillir tous les élèves dans une classe ordinaire, peu importe leurs difficultés personnelles (Vienneau, 2004). Ce principe s'inscrit dans la mouvance du modèle théorique de processus de production du handicap (MDH-PPH) qui vise notamment à modifier l'environnement afin de faciliter l'intégration et la participation sociale des personnes présentant un handicap (Fougeyrollas, 2018; Fougeyrollas et al., 2020). Contrairement au modèle biomédical qui conçoit la personne en situation de handicap comme responsable de son sort, le MDH-PPH se veut un modèle écosystémique selon lequel la situation de handicap évolue en fonction de l'interaction entre des facteurs personnels (p. ex., la sévérité du handicap) et des facteurs environnementaux (p. ex., les stratégies d'enseignement, l'accès à des outils; Fougeyrollas, 2018; Fougeyrollas et al., 2020). En effet, la participation sociale de l'élève en situation de handicap à l'école est dépendante des facilitateurs ou des obstacles de son environnement.

Ainsi, le modèle des FAT, développé par Tremblay et Chouinard (2013), s'appuie fortement sur les principes du MDH-PPH. Lorsque les FAT sont proposées à l'élève selon ses besoins spécifiques, elles sont considérées comme des facilitateurs qui lui permettent de déployer son plein potentiel, malgré sa situation de handicap. Tremblay et Chouinard (2013) suggèrent d'évaluer cette valeur ajoutée en mesurant les améliorations obtenues à des épreuves réalisées à l'aide des FAT (p. ex., la diminution des fautes d'orthographe). Or, à l'heure actuelle, peu d'études empiriques ont été menées pour documenter leur efficacité.

Parmi les FAT les plus étudiées pour la lecture, il y a la *synthèse vocale* qui, en convertissant un texte numérique en parole synthétique, offre une rétroaction vocale à l'élève qui peine à décoder et à reconnaître les mots (Service national du Récit en adaptation scolaire, 2021). Une méta-analyse s'est intéressée à l'utilité de cette FAT sur l'amélioration en compréhension de lecture auprès de jeunes scolarisés en anglais et présentant des difficultés à lire (Wood et al., 2018). Les auteurs n'ont recensé

que 22 études entre 1993 et 2014, dont certaines portent sur la synthèse vocale ($n$ = 13) et d'autres sur la lecture assistée par la voix humaine ($n$ = 9). Les résultats montrent que la rétroaction vocale améliore la compréhension de lecture avec une petite taille d'effet ($g$ de Hedges = ,35), et ce, peu importe la modalité (synthèse vocale ou voix humaine).

Pour compenser les difficultés en écriture, il y a le *correcteur* qui repère et corrige les fautes en les soulignant et en suggérant un choix de réponses (Lange et al., 2006). Son utilité est documentée dans deux revues de la littérature qui, ensemble, n'ont inclus que cinq études menées entre 1990 et 2009 auprès d'élèves du primaire et du secondaire scolarisés en anglais (Batorowicz et al., 2012; MacArthur, 2014). Ces recensions suggèrent que, comparativement à une révision papier-crayon, le correcteur aide à faire moins de fautes, dont les fautes liées à l'orthographe d'usage, à la grammaire et aux homophones. Dans les revues avec comité de pairs, une seule étude plus récente a été répertoriée concernant l'utilité du correcteur, mais auprès d'étudiants avec et sans dyslexie fréquentant une université en anglais (O'rourke et al., 2020). Bien que la nature des fautes n'ait pas été précisée, les résultats montrent que le correcteur a permis de réduire les fautes lors de la rédaction d'un texte, avec de grandes tailles d'effet pour ceux qui ont une dyslexie ($\eta_p^2$ = ,79) et ceux qui n'en ont pas ($\eta_p^2$ = ,43). De plus, l'utilisation du correcteur a permis d'éliminer les écarts de performance entre les deux groupes.

Une autre FAT utilisée en écriture est le *prédicteur de mots* qui, par une analyse des premières lettres tapées au clavier, affiche une liste de mots correspondant à ce que l'élève veut écrire (Anderson et al., 2009). Ce dernier sélectionne ensuite le mot voulu pour l'introduire dans son texte (Herold et al., 2008). Quant à l'utilité de cette FAT pour les difficultés d'écriture, les revues de littérature de MacArthur (2014) et de Batorowicz et al. (2012) n'ont recensé que sept études menées entre 1998 et 2010 auprès d'élèves du primaire et du secondaire, scolarisés en anglais ou en espagnol. Aucune autre étude plus récente n'a été recensée dans les revues avec comité de pairs. Néanmoins, les résultats de ces deux recensions de la littérature montrent que, comparativement à une écriture manuscrite, le prédicteur de mots permet de réduire le nombre de fautes, et ce, qu'il soit utilisé comme seule FAT ou qu'il soit combiné avec d'autres FAT comme la synthèse vocale ou le correcteur. Bien qu'intéressantes, ces études comportent des limites méthodologiques. En effet, 75 % d'entre elles ont de très petits échantillons ($N = \leq 10$) et leurs résultats ne portent que sur le nombre total de fautes, sans distinguer les types (fautes de conversion phonèmes-graphèmes, d'orthographe d'usage ou de grammaire).

Par ailleurs, au fil de ses expériences de vie, l'enfant s'évalue et se forge des perceptions de lui-même, tantôt positives, tantôt négatives. C'est ce que Shavelson et al. (1976) définissent comme étant le *concept de soi*, un construit qu'ils modélisent selon une structure hiérarchisée et multidimensionnelle. Selon ce construit, chaque enfant a un concept de soi général (p. ex., « je suis une bonne personne »), mais également des concepts de soi particuliers qui diffèrent selon les domaines de la vie, non scolaires (aspects physiques, sociaux et émotionnels) ou scolaires (p. ex., « je suis bon à l'école »). Le concept de soi scolaire (CSS) peut même se fractionner en concepts de soi encore plus spécifiques (p. ex., en mathématiques, en lecture, en écriture). Dans le domaine de

l'éducation, le CSS est important, car il est relié à la réussite scolaire (Marsh et al., 2018). Or, pour les élèves qui ont des difficultés d'apprentissage, il est clairement établi que leur CSS est souvent plus faible que celui de leurs pairs tout-venant, alors que le concept de soi général et leurs concepts de soi non scolaires sont similaires (Bear et al., 2002; Gibby-Leversuch et al., 2021; Huang et al., 2021). Ce constat est préoccupant puisque les élèves qui ont un faible CSS sont susceptibles d'accorder moins de valeur à leurs études (Schütte et al., 2017) et de moins s'engager dans celles-ci (Schnitzler et al., 2021), en plus d'être plus à risque de décrochage scolaire (Korhonen et al., 2014).

Pour expliquer l'écart entre le CSS des élèves avec et sans difficulté d'apprentissage, le modèle théorique du *Gros-poisson-petit-bassin* (en anglais, Big-Fish-Little-Pond-Effect, BFLPE) (Marsh, 1984, 1987; Marsh & Parker, 1984) est souvent évoqué (Krämer et al., 2021; Szumski & Karwowski, 2015). Selon ce modèle, l'élève a tendance à comparer sa performance scolaire à celle de la moyenne des élèves de sa classe. Ainsi, plus l'écart à la moyenne est grand, c'est-à-dire que plus la moyenne de l'élève est inférieure à celle de la classe, plus le CSS est qualifié de faible; on fait alors référence à un petit poisson dans un grand bassin. Inversement, une perception de sa performance scolaire supérieure à celle de la moyenne de la classe est associée à un CSS élevé; on fait alors référence à un grand poisson dans un petit bassin. Au Québec, les élèves avec des difficultés d'apprentissage sont majoritairement intégrés dans les classes ordinaires (Ducharme et al., 2018), leurs performances scolaires sont donc constamment comparées à celles de leurs camarades de classe; ce qui risque de nuire à leur CSS. Si les FAT sont utiles pour améliorer leurs compétences en lecture et en écriture, il est possible qu'au fil du temps elles permettent de diminuer l'écart entre leurs performances scolaires et celles de leurs camarades de classe; améliorant ainsi leur CSS.

À notre connaissance, l'utilité des FAT pour améliorer le CSS n'a été vérifiée que par quatre études longitudinales. Celles-ci ont évalué le CSS avant et après l'utilisation de FAT. Dans les deux études où le CSS a été mesuré par un seul score englobant plusieurs dimensions, aucune amélioration n'a été détectée auprès de jeunes scolarisés en suédois ou en italien (Lindeblad et al., 2019; Milani et al., 2010). Or, lorsque plusieurs dimensions du CSS ont été mesurées (lecture, rédaction de textes, épellation de mots, mathématiques, facultés intellectuelles générales), des améliorations ont été observées chez des adolescents scolarisés en anglais, plus spécifiquement en lecture ($\eta_p^2$ = ,14) et pour les facultés intellectuelles générales ($\eta_p^2$ = ,12) (Chiang & Jacobs, 2009). Dans une étude à niveaux de base multiples menée au Québec auprès d'adolescents scolarisés en français, des améliorations du CSS en écriture sont aussi rapportées (Dumont et al., 2019). Les résultats de ces deux dernières études montrent donc la nécessité de mesurer plusieurs dimensions du CSS.

À l'heure actuelle, les FAT sont bien implantées en Amérique du Nord (Bowser et al., 2015) et le Québec ne fait pas exception (Rioux, 2019). Conformément au MDH-PPH, l'octroi de ces mesures vise à diminuer les obstacles liés aux difficultés d'apprentissage, afin que l'élève en situation de handicap puisse déployer son plein potentiel et surmonter ses difficultés. Toutefois, l'utilisation des FAT en milieu scolaire implique des investissements majeurs. Seulement pour 2019-2020, 8 millions de dollars ont été investis (Ministère de l'Éducation et de l'Enseignement supérieur, 2019). Pourtant, peu d'études ont examiné leur utilité et les quelques études menées à ce jour ont surtout été réalisées

auprès d'élèves scolarisés en anglais. En effet, un nombre anémique d'études a été mené auprès d'élèves scolarisés en français et, parmi celles recensées, aucune ne s'est intéressée à l'utilité des FAT au primaire, alors que c'est essentiellement à ce niveau qu'elles sont introduites aux élèves. De plus, afin de vérifier si, au fil du temps, le CSS et les performances en lecture et en écriture deviennent similaires à ceux des élèves tout-venant, il importe d'inclure un groupe de comparaison avec des élèves sans difficulté d'apprentissage, ce que peu d'études ont fait jusqu'à maintenant.

## Objectifs et Hypothèses

Cette étude pilote a pour objectif de documenter l'utilité des FAT auprès d'élèves du primaire qui ont des difficultés en lecture et en écriture (groupe FAT). De façon plus spécifique, l'étude vise à évaluer si l'utilisation des FAT permet d'améliorer la performance à des épreuves qui mesurent (1) la compréhension de lecture et (2) le nombre de fautes dans un texte, (a) les erreurs liées à la conversion phonèmes-graphèmes, (b) les erreurs liées à l'orthographe d'usage, et (c) les erreurs liées à la grammaire. L'étude vise également à vérifier si l'utilisation des FAT permet à ces élèves de renforcer (3) leur CSS dans les dimensions spécifiques, (a) en lecture, (b) en rédaction de textes, (c) en épellation de mots, et pour (d) les facultés intellectuelles générales.

Pour ce faire, leurs performances à lire et à écrire, ainsi que leur CSS sont évalués à deux reprises durant l'année scolaire, soit dans les débuts de l'utilisation des FAT, et cinq mois plus tard. Les résultats des élèves du groupe FAT sont comparés à ceux d'élèves tout-venant qui n'ont pas de difficulté d'apprentissage et qui n'utilisent pas de FAT (groupe de comparaison).

Nous faisons l'hypothèse que les participants du groupe FAT amélioreront, entre les deux temps de mesure, leurs performances (1) en compréhension de lecture et (2) en écriture pour les fautes (a) de conversion phonèmes-graphèmes, (b) d'orthographe d'usage, et (c) de grammaire, ainsi que (3) leur CSS (a) en lecture, (b) en rédaction de textes, (c) en épellation de mots, et pour (d) les facultés intellectuelles générales. De plus, nous faisons l'hypothèse que ces améliorations seront plus prononcées pour le groupe FAT que pour le groupe de comparaison; permettant ainsi d'exclure la possibilité que les améliorations du groupe FAT soient uniquement dues au passage du temps ou à l'enseignement régulier.

## Méthode

### Participants

Pour vérifier l'utilité des FAT, les performances des participants du groupe FAT sont comparées à celles des participants d'un groupe de comparaison, avant l'introduction des FAT (pré-test) et après cinq mois d'utilisation des FAT (post-test). Quarante-sept participants âgés entre 8 et 12 ans inclusivement sont recrutés dans dix écoles des Centres de services scolaires de la Vallée-des-Tisserands et de Laval. Ils sont tous scolarisés en français, en classe ordinaire. Leur niveau scolaire varie de la 3$^{e}$ à la 6$^{e}$ année. Chaque participant du groupe FAT ($n$ = 25; 10 filles et 15 garçons; $M$ de

l'âge = 10,08 ans, *ET* = 1,15) est apparié à un autre du groupe de comparaison en fonction de l'âge, du niveau scolaire et du groupe classe (*n* = 22; 8 filles et 14 garçons; *M* de l'âge = 9,95 ans, *ET* = ,99). Il est à noter que les deux groupes sont comparables pour l'âge (*t*[45] = ,3, *p* = ,539) et le sexe (□² [1, *N* = 47] = ,65; *p* = ,798).

## Instruments de mesure

### *Épreuve de compréhension de lecture*

La compréhension de lecture est évaluée à l'aide des formes A et B de l'épreuve « Compréhension de la lecture silencieuse » incluse dans la batterie Analyse du savoir lire (ANALEC), qui est conçue pour les élèves de 8 ans à l'âge adulte (Inizan, 1998). Elle consiste à lire silencieusement un court texte, puis à répondre par écrit à cinq questions (p. ex., vrai ou faux, questions d'inférences). L'équivalence des formes A et B de l'épreuve est satisfaisante pour la fidélité test-retest (*r* = ,76 - ,88). Le degré de difficulté est ajusté à l'âge du participant et la durée d'administration est de 10 minutes. Les analyses sont réalisées sur le score du nombre total de bonnes réponses.

### *Épreuve d'écriture*

L'épreuve d'écriture est l'épreuve de Chronosdictées (Baneath et al., 2006) qui est une dictée de cinq à huit phrases pendant laquelle les participants sont encouragés à prendre le temps nécessaire pour corriger les fautes. Le degré de difficulté est adapté au niveau scolaire du participant. La durée d'administration est d'environ 15 minutes. Pour l'étude, trois catégories de fautes sont cotées et analysées : (a) de conversion phonèmes-graphèmes (p. ex., « copine » écrit « coupni »), (b) d'orthographe d'usage (p. ex., mots réguliers et irréguliers), et (c) de grammaire (p. ex., accord en genre et en nombre, etc.). Les analyses sont réalisées sur les scores du nombre total de fautes pour chaque catégorie.

### *Concept de soi scolaire*

Ce construit est évalué avec le questionnaire autorapporté *Self-perception profile for learning disabled students* ([SPPLD]; Renick & Harter, 2012). Le questionnaire est traduit en français et cette version est utilisée avec l'autorisation de l'auteure principale, Mari Jo Renick. Le SPPLD évalue neuf dimensions du concept de soi. En raison des hypothèses de notre étude, seulement quatre sous-échelles sont sélectionnées pour mesurer le CSS dans les dimensions (a) en lecture, (b) en rédaction de textes, (c) en épellation de mots, (d) pour les facultés intellectuelles générales, c'est-à-dire la perception d'être un élève intelligent, qui apprend facilement. Pour s'assurer d'une bonne compréhension de chacune des questions, l'évaluateur lit les questions à haute voix. Chaque item présente deux énoncés opposés et le participant choisit celui auquel il s'identifie le plus (Item 33 : « certains jeunes lisent assez vite, alors que d'autres jeunes lisent assez lentement »). Les sous-échelles sont cotées avec une échelle de type Likert. La cohérence interne des sous-échelles est bonne pour les échantillons d'enfants avec et sans difficulté d'apprentissage ($\alpha$ = ,78 à ,89 et $\alpha$ = ,80 à ,90 respectivement). Les analyses sont réalisées sur les scores totaux pour chaque sous-échelle.

## Procédure

Les participants du groupe FAT sont choisis par l'orthopédagogue de l'école selon les critères suivants : (1) présenter des difficultés en lecture et en écriture suffisamment importantes pour que l'élève ait été sélectionné pour recevoir des services d'orthopédagogie à l'école, (2) utiliser au moins une nouvelle FAT depuis moins de six mois. Dans le groupe FAT, certains participants ont un diagnostic de dyslexie ou de trouble du déficit de l'attention avec ou sans hyperactivité (TDAH ou TDA) alors que certains présentent des difficultés d'apprentissage, sans avoir de diagnostic établi par un professionnel reconnu au sens de la loi québécoise (voir le Tableau 1 pour les détails). Les participants du groupe de comparaison sont identifiés par leur enseignant d'après ces critères : (1) ne pas présenter de difficulté en lecture et en écriture, (2) ne pas utiliser de FAT.

Pour chaque participant, le choix des FAT est déterminé selon les besoins identifiés par l'équipe-école. Pour développer leurs compétences à utiliser leurs FAT, tous reçoivent des sessions d'entraînement offertes par un orthopédagogue ou un enseignant à une fréquence approximative de 1,91 (*ET* = 1,019) fois par semaine durant l'année scolaire.

La passation des instruments de mesure est menée par deux psychologues scolaires et par deux étudiants au doctorat en psychologie. Les participants des deux groupes sont rencontrés individuellement au milieu et à la fin de l'année scolaire pour mesurer leurs performances en compréhension de lecture et en écriture, ainsi que pour mesurer leur CSS. La durée moyenne entre les temps de mesure est de cinq mois (*ET* = ,70) pour le groupe FAT et de 4,58 mois (*ET* = ,83) pour le groupe de comparaison, sans différence significative ($t[45] = 1{,}987$, $p = ,166$).

Au temps 1, l'ensemble des instruments de mesure est administré papier-crayon pour tous les participants. Pour situer la performance de base, les participants du groupe FAT n'utilisent pas leurs FAT aux épreuves de lecture et d'écriture.

Au temps 2, l'ensemble des instruments de mesure est administré papier-crayon uniquement pour les participants du groupe de comparaison. Pour le groupe FAT, les épreuves de compréhension de lecture et d'écriture sont administrées à l'ordinateur sur un traitement de texte afin de situer leur performance quand ils utilisent leurs FAT. Le questionnaire de CSS leur est administré papier-crayon.

**Tableau 1**

*Difficultés rapportées chez les participants du groupe FAT (n = 25)*

| Difficultés rapportées | *n* | *%* |
|---|---|---|
| Dyslexie | 2 | 8 |
| Dyslexie avec TDA ou TDAH | 8 | 32 |
| TDA ou TDAH avec difficulté en lecture ou en écriture | 6 | 24 |
| Difficulté en lecture ou en écriture sans diagnostic connu | 9 | 36 |

### Fonctions d'aide technologique

Au temps 2, les FAT utilisées pour la passation des instruments de mesure sont : (1) la synthèse vocale, avec un paramètre de mise en surbrillance du mot lu, offerte par les logiciels Lexibar (Haylem, 2018) et Word Q (Quillsoft, 2018), (2) le prédicteur de mots, avec un paramètre de synthèse vocale pour la lecture de liste de mots, offert par les logiciels Lexibar et Word Q, (3) le correcteur avec un repérage et une correction des fautes d'écriture, offert par le traitement de texte de Microsoft Word et les logiciels Antidote (Druide informatique, 2018) et Lexibar.

## Analyses Statistiques

Les analyses statistiques sont menées avec le logiciel IBM SPSS Statistics (version 26). La normalité de la distribution des huit variables dépendantes est vérifiée selon les critères de Tabachnick et Fidell (2007). Les variables suivantes satisfont les critères de normalité : (1) la compréhension de lecture et (3) le CSS (b) en rédaction de textes, (c) en épellation de mots, et (d) pour les facultés intellectuelles générales. Les analyses sont donc menées sur leurs scores bruts. Par ailleurs, les variables qui ne satisfont pas les critères de normalité sont transformées. Ainsi, pour la performance (2) en écriture, une transformation par la racine carrée est appliquée pour corriger l'asymétrie positive (a) des fautes de conversion phonèmes-graphèmes et (c) des fautes de grammaire, et une transformation logarithmique est nécessaire pour normaliser l'asymétrie positive et l'aplatissement de la distribution (b) des fautes d'orthographe d'usage. Les analyses sont réalisées sur les scores transformés.

Les variables de l'âge ($t$[45] = ,3, $p$ = ,539) et du sexe ($\chi^2$ [1, $n$ = 47] = ,65;  = ,798) sont comparables chez les participants des deux groupes, elles ne sont donc pas retenues pour les analyses subséquentes.

Pour (2) le CSS (a) en lecture, une donnée extrême (≥ -3) du groupe de comparaison affecte la normalité de la distribution. Puisque les transformations par la racine carrée et logarithmique ne corrigent pas la situation, une winsorisation est appliquée : la donnée extrême est changée pour qu'elle se rapproche de l'avant-dernière donnée la plus petite de la distribution (Tabachnick & Fidell, 2007). Après cet ajustement, la distribution est normalisée et les analyses sont effectuées avec la variable winsorisée.

Des analyses de la variance à mesures répétées 2 x 2 (Groupes x Temps de mesures) sont menées sur les huit variables pour comparer les scores des participants du groupe FAT à ceux du groupe de comparaison. Une interaction Groupes x Temps de mesure est recherchée pour mesurer les effets des FAT, mais aussi pour mesurer les effets du passage du temps et de l'enseignement régulier chez les participants du groupe de comparaison.

Si l'interaction est significative ($p$ < ,05), des analyses des effets simples sont menées pour comparer (1) les moyennes des temps de mesure pour chaque groupe et (2) les moyennes des groupes pour chaque temps de mesure. L'éta carré partiel ($\eta_p^2$) est indiqué pour mesurer la force de l'interaction, des effets principaux et des effets simples. Son interprétation est faite selon le libellé *petite* (autour de ,01), *moyenne* (autour de ,06) et *grande* (autour de ,14) proposé par Cohen (2013).

# Résultats

## Évolution des performances en compréhension de lecture

L'interaction entre les groupes et les temps de mesure n'est pas significative ($p$ = ,357) et il n'y a pas d'effet principal du temps de mesure ($p$ = ,828). Toutefois, les résultats montrent un effet principal du groupe avec une grande taille d'effet ($F$[l, 45] = 32,278, $p$ < ,001, $\eta_p^2$ = ,418). Aux deux temps de mesure, les participants du groupe de comparaison obtiennent de meilleurs scores que ceux du groupe FAT. Les scores de compréhension de lecture au temps 1 et au temps 2 sont respectivement de 5,48 ($ET$ = 2,62) et 5,04 ($ET$ = 2,61) pour le groupe FAT et de 8,23 ($ET$ = 1,66) et 8,5 ($ET$ = 1,99) pour le groupe de comparaison.

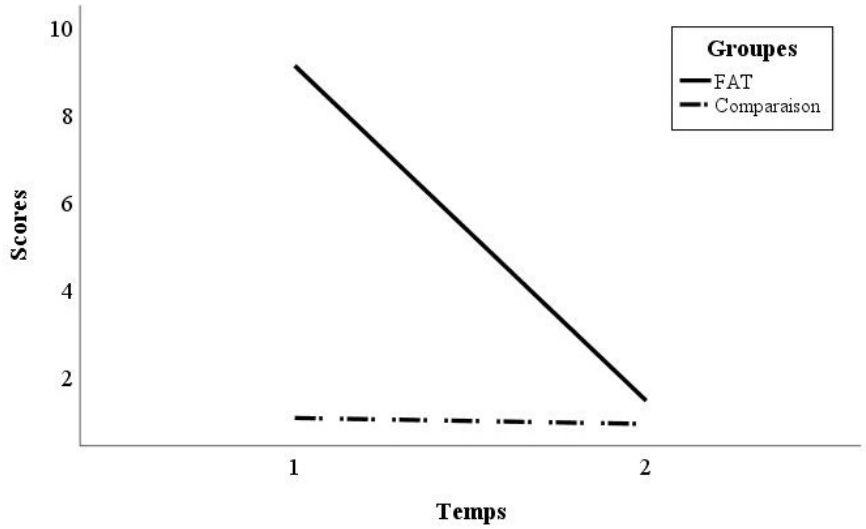
## Évolution des performances en écriture

### *Fautes de conversion phonèmes-graphèmes*

Les résultats sont significatifs pour l'interaction entre les groupes et les temps de mesure ($F$[l, 45] = 50,497, $p$ < ,001, $\eta_p^2$ = ,529), l'effet principal du temps de mesure ($F$[l, 45] = 55,293, $p$ < ,001, $\eta_p^2$ = ,551) et l'effet principal du groupe ($F$[l, 45] = 40,263,  < ,001, $\eta_p^2$ = ,472). L'examen des effets simples indique qu'entre les temps de mesure l'amélioration est significative pour les scores du groupe FAT, avec une grande taille d'effet ($F$[l, 45] =112,945, $p$ <  001, $\eta_p^2$ = ,715). En revanche, il n'y a pas de changement significatif pour le groupe de comparaison ($p$ = ,822). Pour le second examen des effets simples, les résultats révèlent qu'au temps 1, les participants du groupe de comparaison ont de meilleurs scores que ceux du groupe FAT ($F$[l, 45] = 65,855, $p$ < ,001, $\eta_p^2$ = ,594). Cependant, comme l'illustre la Figure 1, les deux groupes obtiennent des résultats comparables au temps 2, puisqu'il n'y a plus de différence significative ($p$ = ,348). Les scores des fautes de conversion phonèmes-graphèmes au temps 1 et au temps 2 sont respectivement de 9,12 ($ET$ = 5,55) et 1,44 ($ET$ = 2) pour le groupe FAT et de 1,05 ($ET$ = 1,56) et 0,91 ($ET$ = 1,54) pour le groupe de comparaison.

**Figure 1**

*Scores des fautes de conversion phonèmes-graphèmes*

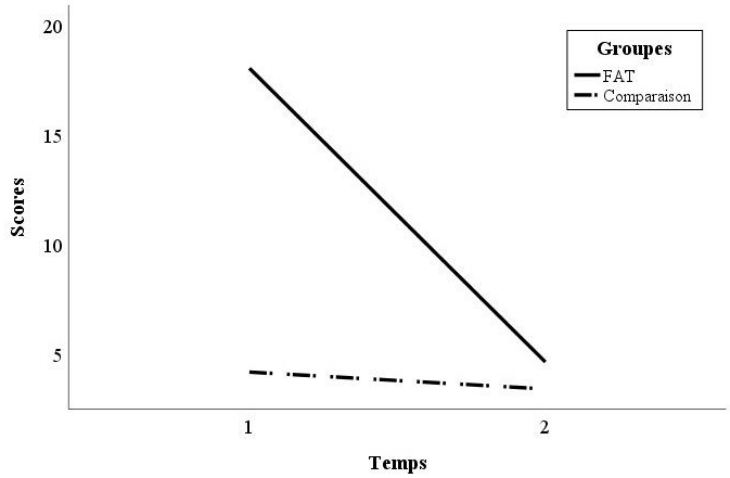



***Fautes d'orthographe d'usage***

Les résultats sont significatifs pour l'interaction entre les groupes et les temps de mesure ($F$[l, 45] = 49,824, $p$ < ,001, $\eta_p^2$ = ,525), l'effet principal du temps de mesure ($F$[l, 45] = 76,001, $p$ < ,001, $\eta_p^2$ = ,628) et l'effet principal du groupe ($F$[l, 45] = 33,988, $p$ < ,001, $\eta_p^2$ = ,43). L'observation des effets simples indique qu'entre les temps de mesure l'amélioration est significative pour les scores du groupe FAT, avec une grande taille d'effet ($F$[l, 45] =132,934, $p$ < ,001, $\eta_p^2$ = ,747). Pour le groupe de comparaison, n'y a pas de changement significatif ($p$ = ,261). Ensuite, le deuxième examen des effets simples révèle que les participants du groupe de comparaison ont de meilleurs scores comparativement à ceux du groupe FAT au temps 1 ($F$[l 45] = 92,836, $p$ < ,001, $\eta_p^2$ = ,674). En contrepartie, les scores des deux groupes sont comparables au temps 2 ($p$ = ,319), comme l'illustre la Figure 2. Les scores des fautes liées à l'orthographe d'usage au temps 1 et au temps 2 sont respectivement de 18,04 ($ET$ = 6,69) et 4,6 ($ET$ = 4,56) pour le groupe FAT et de 4,14 ($ET$ = 2,83) et 3,36 ($ET$ = 2,77) pour le groupe de comparaison.

**Figure 2**

*Scores des fautes d'orthographe d'usage*

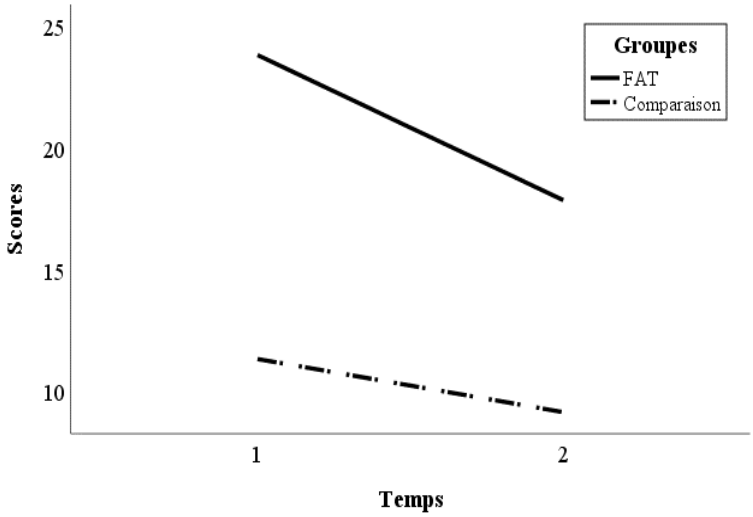



### *Fautes de grammaire*

Pour les fautes de grammaire, l'interaction entre les groupes et les temps de mesure est significative ($F$[l, 45] = 4,536, $p$ = ,039, $\eta_p^2$ = ,092). L'effet principal du temps de mesure ($F$[l ,45] = 37,029, p < ,001, $\eta_p^2$ = ,451) et l'effet principal du groupe ($F$[l, 45] = 54,880, $p$ < ,001, $\eta_p^2$ = ,549) sont aussi significatifs. L'examen des effets simples montre que les scores s'améliorent entre les temps de mesure pour les deux groupes, avec de grandes tailles d'effet : FAT ($F$[l, 45] = 36,043, $p$ < ,001, $\eta_p^2$ = ,445) et comparaison ($F$[l, 45] =7,353, $p$ < ,009, $\eta_p^2$ = ,140). Pour le deuxième examen des effets simples, les résultats révèlent que les participants du groupe de comparaison obtiennent de meilleurs scores comparativement à ceux du groupe FAT et que ces différences sont significatives avec de grandes tailles d'effet au temps 1 ($F$[l, 45] = 65,557, $p$ < ,001, $\eta_p^2$ = ,593) et au temps 2 ($F$[l, 45] =30,566, $p$ < ,001, $\eta_p^2$ = ,404), comme l'illustre la Figure 3. Les scores des fautes de grammaire au temps 1 et au temps 2 sont respectivement de 23,8 ($ET$ = 6,22) et 17,84 ($ET$ = 7,26) pour le groupe FAT et de 11,32 ($ET$ = 4,4) et 9,14 ($ET$ = 3,83) pour le groupe de comparaison.

**Figure 3**

*Scores des fautes de grammaire*




## Évolution du Concept de Soi Scolaire

### *Concept de soi scolaire en lecture*

L'interaction entre les groupes et les temps de mesure ($F$[l, 45] = ,679, $p$ = ,414) et l'effet principal du temps ($F$[l, 45] = ,501, $p$ = ,483) ne sont pas significatifs. En revanche, l'effet principal du groupe s'avère significatif ($F$[l, 45] = 70,070, p < ,001, $\eta_p^2$ =,609). Ceci indique qu'aux deux temps de mesure les participants du groupe de comparaison obtiennent de meilleurs scores que ceux du groupe FAT. Se référer au Tableau 2 pour les moyennes et les écarts types des variables du CSS.

**Tableau 2**

*Moyennes et écarts types pour les scores bruts du CSS (n = 47)*

| Variables | | Temps 1 | | Temps 2 | |
|---|---|---|---|---|---|
| | | *M* | *ET* | *M* | *ET* |
| CSS en lecture | FAT | 8,80 | 3,39 | 9,40 | 3,12 |
| | Comparaison | 14,64 | 1,47 | 14,59 | 1,74 |
| CSS en rédaction de textes | FAT | 9,16 | 2,91 | 9,96 | 2,24 |
| | Comparaison | 13,00 | 1,98 | 13,00 | 2,60 |
| CSS en épellation de mots | FAT | 9,40 | 2,63 | 10,60 | 2,02 |
| | Comparaison | 13,27 | 1,70 | 13,55 | 2,37 |
| CSS pour les facultés intellectuelles générales | FAT | 11,92 | 2,75 | 12,48 | 2,14 |
| | Comparaison | 17,77 | 2,29 | 16,86 | 2,30 |

### *Concept de soi scolaire en rédaction de textes*

L'interaction entre les groupes et les temps de mesure ($F$[l, 45] = 1,170, $p$ = ,285) et l'effet principal du temps ($F$[l, 45] = 1,170, $p$ = ,285) ne sont pas significatifs. Toutefois, l'effet principal du groupe est significatif ($F$[l, 45] = 30,825, p < ,001, $\eta_p^2$ = ,407); les participants du groupe de comparaison ont de meilleurs scores que ceux du groupe FAT aux deux temps de mesure.

### *Concept de soi scolaire en épellation de mots*

L'interaction entre les groupes et les temps de mesure n'est pas significative ($F$[l, 45] = 1,809, $p$ = ,185). En revanche, les effets principaux du temps ($F$[l, 45) = 4,562, $p$ = ,038, $\eta_p^2$ = ,092) et du groupe ($F$[l, 45] = 38,657, p < ,001, $\eta_p^2$ = ,462) sont significatifs. Autrement dit, le CSS en épellation de mots augmente pour l'ensemble des participants et ceux du groupe de comparaison obtiennent de meilleurs scores que ceux du groupe FAT.

### *Concept de soi scolaire pour les facultés intellectuelles générales*

L'interaction entre les groupes et les temps de mesure ($F$[l, 45] = 3,157, $p$ = ,082) et l'effet principal du temps ($F$[l, 45] = ,178, $p$ = ,675) ne sont pas significatifs. Toutefois, l'effet principal du groupe est significatif ($F$[l, 45] = 82,964, p < ,001, $\eta_p^2$ = ,648). Aux deux temps de mesure, les participants du groupe de comparaison ont de meilleurs scores que ceux du groupe FAT.

## Discussion

Cette étude pilote vise à documenter l'utilité des FAT auprès d'élèves du primaire scolarisés en français et qui présentent des difficultés dans l'apprentissage de la lecture et de l'écriture (groupe FAT). Plus spécifiquement, l'objectif est de mieux comprendre l'utilité des FAT sur l'amélioration de leurs performances en compréhension de lecture et en écriture. Pour ce faire, leurs performances sont comparées à celles d'élèves tout-venant issus des mêmes classes (groupe de comparaison). Les deux groupes sont évalués à deux reprises, dans les débuts de l'utilisation des FAT et cinq mois plus tard.

D'abord, le constat le plus intéressant de l'étude est l'amélioration substantielle qu'obtiennent les élèves du groupe FAT en écriture. En effet, les résultats montrent des effets d'interaction significatifs entre les deux groupes et les deux temps de mesure pour les trois variables d'écriture. Ainsi, pour les fautes de conversion phonèmes-graphèmes et les fautes d'orthographe d'usage, les analyses des effets simples montrent qu'entre les temps de mesure les performances du groupe FAT s'améliorent avec de grandes tailles d'effet ($\eta_p^2$ = ,715 et $\eta_p^2$ = ,747), alors que celles du groupe de comparaison demeurent stables. De plus, après seulement cinq mois d'utilisation des FAT, les résultats montrent qu'il n'y a plus de différence entre les performances des deux groupes. Ainsi, l'utilisation des FAT a permis aux élèves qui rencontrent des difficultés d'apprentissage en lecture et en écriture d'obtenir des performances similaires à celles de leurs camarades tout-venant. Ces résultats sont très importants, car chez les élèves qui ont une dyslexie ou qui sont à risque de présenter ce trouble, les fautes d'écriture sont surtout liées à la conversion phonèmes-graphèmes ou à l'orthographe d'usage

(Guay, 2019). Or, c'est précisément sur ce type de fautes que les participants du groupe FAT ont rattrapé la moyenne de leurs pairs tout-venant.

Pour les fautes de grammaire, les analyses indiquent que tous les participants ont amélioré leurs performances entre les deux temps de mesure, avec de grandes tailles d'effet pour le groupe FAT ($\eta_p^2$ = ,445) et le groupe de comparaison ($\eta_p^2$ = ,140). Notons qu'il est normal d'observer de telles améliorations, puisque tous les participants ont tiré profit de l'enseignement régulier pendant cinq mois. Toutefois, les résultats montrent également un effet d'interaction entre les deux groupes et les deux temps de mesure. Même si, au temps 2, les participants du groupe FAT continuent de faire plus de fautes de grammaire que ceux du groupe de comparaison, ils ont tout de même obtenu de plus grandes améliorations que leurs pairs tout-venant. En effet, pour le groupe FAT, les fautes de grammaire sont passées de 23,8 à 17,84, alors que pour le groupe de comparaison, elles sont passées de 11,32 à 9,14. Parmi les études sur l'utilité des FAT dans l'apprentissage de l'anglais, peu ont distingué les différents types de fautes. Or, ces distinctions sont importantes pour mieux comprendre l'utilité des FAT, surtout en contexte francophone, puisque les règles de grammaire sont plus nombreuses et complexes qu'en anglais (Joye et al., 2020).

Pour la compréhension de lecture, les résultats montrent qu'aux deux temps de mesure la performance du groupe de comparaison est supérieure à celle du groupe FAT. De plus, l'interaction groupe par temps de mesure n'est pas significative. Ainsi, l'utilisation de la synthèse vocale n'a pas permis aux élèves du groupe FAT d'améliorer leur performance. Ces résultats diffèrent de ceux de la méta-analyse de Wood et al. (2018) révélant que la synthèse vocale permet à des élèves scolarisés en anglais d'améliorer leur performance en compréhension de lecture. Toutefois, précisons que leur taille d'effet était petite (*g* de Hedges = ,35). Il est donc important que davantage d'études soient menées pour mieux comprendre les conditions dans lesquelles la synthèse vocale est efficace.

Somme toute, selon le MDH-PPH, les FAT constituent une modification de l'environnement qui vise à faciliter l'intégration et la réussite des élèves qui ont un handicap en lecture et en écriture (Fougeyrollas, 2018). Les résultats de cette étude pilote sont importants, car ils montrent, avec de surcroît de grandes tailles d'effet, que les élèves qui rencontrent des difficultés d'apprentissage du français et qui utilisent des FAT peuvent obtenir des performances comparables aux autres sur le plan des fautes de conversion phonèmes-graphèmes et des fautes d'orthographe d'usage. Les FAT permettent donc à ces élèves d'être mieux intégrés dans les classes ordinaires, mais surtout, d'être en mesure de répondre aux exigences du programme scolaire. Néanmoins, davantage d'études sont nécessaires pour mieux comprendre si, à l'usage, l'exposition à une bonne orthographe leur permet d'améliorer leurs compétences en écriture, sans l'aide des FAT.

Secondairement, l'étude vise aussi à examiner si les FAT permettent aux élèves qui rencontrent des difficultés à lire et à écrire d'améliorer des dimensions du CSS. Les résultats montrent qu'au fil du temps seule la dimension liée à l'épellation des mots s'améliore dans les deux groupes. Toutefois, il n'y a aucune interaction groupe par temps de mesure; indiquant que l'utilisation des FAT ne permet pas plus d'améliorer les dimensions du CSS que dans le groupe de comparaison. Par ailleurs, les résultats montrent qu'aux deux temps de mesure tous les scores du CSS du groupe de comparaison sont

supérieurs à ceux du groupe FAT; confirmant le fait bien établi que les élèves avec des difficultés d'apprentissage ont des CSS plus faibles que ceux des élèves tout-venant (Gibby-Leversuch et al., 2021; Huang et al., 2021). Les résultats de l'étude diffèrent cependant de ceux de Chiang et Jacobs (2009) qui avaient pourtant montré qu'après dix semaines d'utilisation de FAT des élèves avec des difficultés d'apprentissage avaient amélioré leur CSS dans les dimensions liées à la lecture ($\eta_p^2 =$ ,14) et aux facultés intellectuelles générales ($\eta_p^2 =$ ,12). Or, contrairement à la présente étude où le groupe de comparaison est constitué d'élèves tout-venant sans difficulté d'apprentissage, les dimensions du CSS étaient comparées à celles d'élèves qui ont également des difficultés d'apprentissage, mais qui n'utilisent pas de FAT. Ainsi, il serait pertinent de répliquer les résultats de Chiang et Jacobs (2009) en comparant les dimensions du CSS des élèves qui ont des difficultés d'apprentissage selon qu'ils utilisent ou non des FAT. Par ailleurs, il est possible que le CSS soit relativement stable dans le temps et que cinq mois d'utilisation des FAT ne soient pas suffisamment longs pour détecter des changements. En effet, selon les résultats d'une méta-analyse, les interventions de longue durée (p. ex., un semestre à un an) s'avèrent plus efficaces pour améliorer le CSS (Elbaum & Vaughn, 2001); d'où la nécessité de multiplier les études longitudinales.

## Limites

Certaines limites doivent être soulignées. Premièrement, le groupe FAT est hétérogène étant donné l'inclusion de plusieurs profils de difficultés en lecture et en écriture. En revanche, ces profils s'avèrent représentatifs des élèves qui bénéficient des FAT au Québec (Ministère de l'Éducation et de l'Enseignement supérieur, 2019). En raison du manque de puissance statistique, l'utilité des FAT n'a pu être vérifiée pour chacun des profils (p. ex., groupe dyslexie, groupe TDA-TDAH, etc.), mais cette question devrait être examinée auprès d'un plus grand échantillon. Deuxièmement, l'intensité à laquelle les FAT ont été utilisées en classe n'a pas été documentée entre les temps de mesure. D'après la revue de la littérature de Perelmutter et al. (2017), cette limite est commune dans les études quantitatives sur les FAT. Or, documenter ce type de variables à l'aide de grilles d'observation est coûteux en temps pour les enseignants et les chercheurs. Comme solution alternative, des auteurs ont proposé l'idée d'un nuage (*cloud*) dans lequel seraient compilées des données numériques sur les comportements des utilisateurs des FAT (Lenker et al., 2021; Satterfield, 2016). Un tel projet permettait aux acteurs et aux chercheurs en éducation de collecter des données longitudinales, telles que l'intensité d'utilisation et l'amélioration des performances aux épreuves de lecture et d'écriture (Satterfield, 2016).

## Conclusion

Cette étude pilote confirme que les FAT sont utiles pour les élèves du primaire qui ont des difficultés d'apprentissage en lecture et en écriture et qui sont scolarisés en français. En effet, les résultats montrent qu'avec les FAT ils obtiennent des performances comparables aux autres pour ce qui est des fautes de conversion phonèmes-graphèmes et des fautes d'orthographe d'usage. Ces constats sont importants pour leur réussite. Les intervenants scolaires peuvent dorénavant s'appuyer sur ces

données probantes pour justifier, dès le primaire, le recours aux FAT lorsqu'un élève est en difficulté d'apprentissage en français. Évidemment, davantage d'études sont nécessaires. Il serait notamment intéressant de vérifier si l'usage prolongé des FAT permet à ces élèves non seulement d'améliorer leurs performances en utilisant les FAT pour écrire, mais aussi leurs compétences en écriture, sans l'aide des FAT. Également, il serait intéressant de vérifier si, à la longue, le CSS de ces élèves s'améliore, au fur et à mesure qu'ils progressent et que l'écart entre leur performance et celle de la moyenne de classe se réduit.

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# Automated Scoring of Speaking and Writing: Starting to Hit its Stride

# Notation automatisée de l'expression orale et écrite : Un début prometteur

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## Abstract

This article reviews recent literature (2011–present) on the automated scoring (AS) of writing and speaking. Its purpose is to first survey the current research on automated scoring of language, then highlight how automated scoring impacts the present and future of assessment, teaching, and learning. The article begins by outlining the general background of AS issues in language assessment and testing. It then positions AS research with respect to technological advancements. Section two details the literature review search process and criteria for article inclusion. In section three, the three main themes emerging from the review are presented: automated scoring design considerations, the role of humans and artificial intelligence, and the accuracy of automated scoring with different groups. Two tables show how specific articles contributed to each of the themes. Following this, each of the three themes is presented in further detail, with a sequential focus on writing, speaking, and a short summary. Section four addresses AS implementation with respect to current assessment, teaching, and learning issues. Section five considers future research possibilities related to both the research and current uses of AS, with implications for the Canadian context in terms of the next steps for automated scoring.

*Keywords*: Automated scoring of language; Literature review; Scoring feedback; Technology in language assessment and teaching

## Résumé

Cet article examine la littérature récente (2011 jusqu'à présent) sur la notation automatisée (NA) de l'expression écrite et de l'expression orale. Son objectif est d'abord d'examiner les recherches actuelles sur la notation automatisée de la langue, puis de mettre en évidence l'impact de la notation automatisée sur le présent et l'avenir de l'évaluation, de l'enseignement et de l'apprentissage. L'article commence par décrire le contexte général des problèmes de notation automatisée dans l'évaluation et

les tests linguistiques. Il positionne ensuite la recherche sur la NA par rapport aux avancées technologiques. La deuxième section décrit en détail le processus de recherche de la revue de la littérature et les critères d'inclusion des articles. Dans la troisième section, les trois principaux thèmes qui se dégagent de l'analyse sont présentés : considérations relatives à la conception de la notation automatisée; le rôle des humains et de l'intelligence artificielle; et la précision de la notation automatisée avec différents groupes. Deux tableaux montrent comment des articles spécifiques ont contribué à chacun des thèmes. Ensuite, chacun des trois thèmes est présenté plus en détail, avec un accent séquentiel sur l'expression écrite, l'expression orale et un bref résumé. La quatrième section aborde la mise en œuvre des NA en ce qui concerne les questions actuelles d'évaluation, d'enseignement et d'apprentissage. La cinquième section présente les possibilités de recherche futures liées à la recherche et aux utilisations actuelles de la NA, avec des implications sur le contexte canadien en ce qui concerne les prochaines étapes de la NA.

*Mots-clés* : Notation automatisée de la langue ; revue de littérature ; rétroaction sur la notation ; technologie dans l'évaluation et enseignement des langues

## Background on Automated Scoring

Automated scoring (AS) has been the focus of ongoing academic research and development since the 1960s and has enjoyed increasing attention alongside technological advances (Foltz et al., 2020). In the context of language assessment, AS can be defined as "…using computers to convert students' performance on educational tasks into characterizations of the quality of performance" (Foltz et al., 2020, p. 1). The reasons behind these efforts are varied but often relate to cost reduction, scalability, and capacity for immediate feedback or results, as well as consistency and accuracy of assessment (Foltz et al., 2020). Leveraging these benefits through advances in computing, natural language processing, and machine learning, as well as accessible and cost-efficient technological applications has potential advantages for language assessment, teaching, and learning.

Given the critical role of language in facilitating or limiting opportunities for collaboration and employment access in our connected world (McNamara, 2005; Sackett et al., 2001; Shohamy, 2013), as well as the current systemic challenges of mobilizing assessment, teaching, and learning during a global pandemic (d'Orville, 2020; Voogt & Knezek, 2021), AS is poised to play an important role. Increasing AS implementation can increase access to language assessment, as well as teaching and learning resources, while also deepening our understanding of how to optimize their mobilization and implementation—which the field of language assessment is still grappling with (Schneider & Boyer, 2020). The rapid pace of shifting technological affordances (Wood, 2020) offers both new promise and challenges as many of these technologies require additional application and research to ensure validity and fairness. Facilitating valid, reliable, fair, and easy-to-access AS support of language assessment, teaching, and learning based on a wide range of purposes can help alleviate some of the most critical educational challenges faced today. Some of these educational challenges are assessment bottlenecks for certification or training of internationally trained professionals; limited access due to socio-

economic, pandemic-related, or location-specific pressures; and costs related to developing, operationalizing, and maintaining language scoring approaches.

This article provides a big-picture perspective by synthesizing established research, clarifying current AS capabilities, and pointing to future AS directions. Thus, it informs interested language assessment stakeholders by drawing together current research literature on AS. In essence, this is a scoping review of the literature on state-of-the-art language assessment research. Generally, the four language skills considered are speaking, listening, reading, and writing. Listening and reading are receptive language skills, whereas speaking and writing are productive language skills (Golkova & Hubackova, 2014). Though all four language skills have received attention related to AS, writing and speaking have been the subject of more research and operational implementation (Cahill & Evanini, 2020). Given this established research footing and the clear relevance of productive language skills for education, social participation, and workforce mobilization, the focus of this review is on writing and speaking.

## Criteria for Selecting Studies

Six major databases were selected for the search: Canadian Business and Current Affairs, Education Source, ERIC, PsychNet, Web of Science, and Academic Search Complete. Articles published before 2011 were excluded to ensure the search findings represented state-of-the-art technologies and up-to-date application of AS. Search items were filtered to include empirical articles, technical reports, and literature reviews written in English. The three primary search terms used in the search were "language assessment," "language evaluation," and "language testing." Each database was searched using this primary search term in combination with each of the following nine secondary search terms. The nine secondary search terms were "artificial intelligence," "natural language processing," "deep neural networks," "machine learning," "machine scor*" "machine rating," "automated rating," "automated scoring," and "Coh-Metrix." Thus, the final number of searches across databases was 162 (27 search combinations across 6 databases). An initial list of 193 items was compiled from the search results. These were selected by the researcher after briefly screening the items for relevance. An additional 26 items not found in the search were included as supplemental items. These were identified through references in the search result items and through independent research by the researchers. This total number of 219 articles, technical reports, and reviews was further reduced to 21 articles presenting or expanding upon empirical results. The reduction was based on the degree of focus on either AS of writing or speaking and this was enacted by the primary researcher upon a review of each article's abstract and findings. Ultimately, this resulted in 11 writing-focused articles and 10 speaking-focused articles. The researcher then completed annotated summaries for these. Moreover, five additional articles were identified as relevant literature reviews or surveys of the current state of AS in language assessment. These five items did not present new empirical findings. The result was that a final total of 26 primary items were selected to inform this review of AS in language assessment.

## Key Themes in Automated Scoring of Language Proficiency in Speaking and Writing

Three key themes were identified based on the literature reviews and surveys of the current state of automated assessment. To identify themes, the researchers conducted a thematic analysis of the articles by first coding salient content in the articles and summaries, and then creating main themes and subthemes based on the code groups (Braun & Clarke, 2006). Tables 1 and 2 show how the three identified themes were distributed across the 11 writing-focused and 10 speaking-focused items. The first theme is AS design considerations, that is, a focus on the AS model design, operational practices, or purpose. The second theme is the role of humans and automation when considering both in relation to AS. In other words, this focus centred on how automation and humans combine before, during, and after the AS process to facilitate specialization, provide complementary support, influence scoring, and utilize AS results. The third theme is the accuracy of AS with different groups. Test-taking population differences related to first language (L1), gender, ethnicity, and country can occur between subgroups within the national level of a population or when comparing two different populations at an international level (Bridgeman et al., 2012b; Zhang et al., 2013). Thus, this includes discussion on AS accuracy, viability across population groups and specific populations, and the degree of generalizability. It should be noted that the third theme had less representation across the articles. However, as the examples that do occur relate to AS scalability, transferability, fairness, bias, and quality control as well as assurance, the researchers deemed that it was justifiable to include it as an important if somewhat comparably less salient theme. Further, the theme is addressed as an important one in surveys of the current state of AS (Rupp et al., 2020; Yan & Bridgeman, 2020).

**Table 1**

*Writing Articles and Reports*

| Article title | Author(s) | Year | Theme 1 | Theme 2 | Theme 3 |
|---|---|---|---|---|---|
| Automated subscores for TOEFL iBT® independent essays | Attali | 2011 | ✓ | ✗ | ✓ |
| Comparison of human and machine scoring of essays: Differences by gender, ethnicity, and country | Bridgeman et al. | 2012b | ✗ | ✓ | ✗ |
| Scoring with the computer: Alternative procedures for improving the reliability of holistic essay scoring | Attali et al. | 2012 | ✗ | ✓ | ✗ |
| Investigating the suitability of implementing the e-rater ® scoring engine in a large-scale English language testing program | Zhang et al. | 2013 | ✓ | ✓ | ✓ |

| Article title | Author(s) | Year | Theme 1 | Theme 2 | Theme 3 |
|---|---|---|---|---|---|
| Monitoring of scoring using the e-rater® automated scoring system and human raters on a writing test | Wang & von Davier | 2014 | ✓ | ✓ | ✗ |
| Validity arguments for diagnostic assessment using automated writing evaluation | Chapelle et al. | 2015 | ✓ | ✗ | ✗ |
| The effect of using automated essay evaluation on ESL undergraduate students' writing skill | Aluthman | 2016 | ✓ | ✓ | ✗ |
| The influence of rater effects in training sets on the psychometric quality of automated scoring for writing assessments | Wind et al. | 2018 | ✓ | ✓ | ✗ |
| Machine learning–driven language assessment | Settles et al. | 2020 | ✓ | ✗ | ✗ |
| More efficient processes for creating automated essay scoring frameworks: A demonstration of two algorithms | Shin & Gierl | 2021 | ✓ | ✗ | ✗ |
| Automated scoring of junior and senior high essays using Coh-Metrix features: Implications for large-scale language testing | Latifi & Gierl | 2021 | ✓ | ✗ | ✗ |

*Note.* Theme 1 = AS Design Considerations; Theme 2 = Role of Humans and Artificial Intelligence; Theme 3 = Accuracy of Automated Scoring with Different Groups

**Table 2**

*Speaking Articles and Reports*

| Article title | Author(s) | Year | Theme 1 | Theme 2 | Theme 3 |
|---|---|---|---|---|---|
| A comparison of two scoring methods for an automated speech scoring system | Xi et al. | 2012 | ✓ | ✗ | ✗ |
| TOEFL iBT speaking test scores as indicators of oral communicative language proficiency | Bridgeman et al. | 2012b | ✗ | ✓ | ✗ |
| Automated scoring of speaking tasks in the Test of English-for-Teaching (TEFT™) | Zechner et al. | 2015 | ✓ | ✓ | ✗ |

| Article title | Author(s) | Year | Theme 1 | Theme 2 | Theme 3 |
|---|---|---|---|---|---|
| Deep neural network acoustic models for spoken assessment applications | Cheng et al. | 2015 | ✓ | ✗ | ✓ |
| Comparative evaluation of automated scoring of syntactic competence of non-native speakers | Zechner et al. | 2017 | ✗ | ✓ | ✓ |
| Combining human and automated scores for the improved assessment of non-native speech | Yoon & Zechner | 2017 | ✓ | ✓ | ✗ |
| Monitoring the performance of human and automated scores for spoken responses | Wang et al. | 2018 | ✗ | ✓ | ✗ |
| Automatic assessment of English proficiency for Japanese learners without reference sentences based on deep neural network acoustic models | Fu et al. | 2020 | ✓ | ✗ | ✓ |
| Detecting pronunciation errors in spoken English tests based on multifeature fusion algorithm | Wang | 2021 | ✓ | ✓ | ✗ |
| Using spoken language technology for generating feedback to prepare for the TOEFL iBT® test: A user perception study | Gu et al. | 2021 | ✗ | ✓ | ✗ |

*Note*. Theme 1 = AS Design Considerations; Theme 2 = Role of Humans and Artificial Intelligence; Theme 3 = Accuracy of Automated Scoring with Different Groups

## Automated Scoring Design Considerations

Numerous subthemes related to the automated scoring emerged. These subthemes are related to model design, model implementation considerations, and purposes.

### *Automated Scoring Model Design*

Automated scoring models evaluate different language features (grammatical features, sophistication of vocabulary, usage errors, organization and discourse development) using algorithmic approximation of human rating. However, the processes used by human raters and AS differ. Where human raters match response features to rubrics, AS models extract proxies of rubric features from responses and use them in statistical models to yield predictive evaluations (Schneider & Boyer, 2020). This difference in evaluation processes is one of the main criticisms against AS. Namely, the concern is that AS may create validity issues by focusing on narrowed elements of language and that it may differ in a fundamental way from human rating and evaluation (Douglas, 2013; Schmidgall & Powers, 2017). A variety of AS statistical models can be used (multiple linear regression, lasso regression, nonnegative

least-squares regression, support vector machine, artificial neural network, deep learning, multimodal learning, best linear prediction, etc.); however, it is critical that model assumptions and abnormalities be examined in the contexts of use (Yan & Bridgeman, 2020).

In general, the use of Coh-Metrix approaches has a long track record in the research, whereas deep neural network approaches represent more state-of-the-art implementations. One advantage of the Coh-Metrix feature approach is that it requires smaller training sets than the deep-neural approaches. Moreover, Latifi and Gierl (2021) demonstrated a reasonable fit of Coh-Metrix models for a large-scale AS of essays. They showed that this traditional approach was adept at language capture and assessment across language features in essays. Thus, at present, there are advantages and disadvantages for each, which highlights the importance of selecting a scoring model design that suits the purpose and context of implementation. Both expert hand-crafted feature models and natural language processing feature-inducing AS models (i.e., using deep neural algorithms to learn the language features) are trained using human ratings (Hussein et al., 2019; Wind et al., 2018) or human-judgment informed materials (Settles et al., 2020).

### *How Automated Scoring Feedback is Perceived*

Gu et al. (2021) looked at perceptions of using AS-based feedback for test preparation. Feedback types included domain subscores, task scores, and individual linguistic features. In general, teachers and test takers perceived the automated speaking feedback as being useful, though the teachers were more skeptical of its usefulness when compared with students. This may suggest that the teachers perceived limitations in the feedback that would otherwise benefit from teacher mediation, perhaps underscoring that automated feedback is not at a point where it can completely replace teachers. It may also suggest that the teachers were better able to evaluate the strengths and weaknesses of the feedback than were the test takers, at least in terms of their understanding of language and feedback usefulness. Nonetheless, automated feedback on speaking does seem to be perceived, by both teachers and learners, as being somewhat valuable for learning and teaching purposes.

### *Automated Scoring Implementation Focus*

The focus of the scoring model can also vary significantly. For example, general scoring models can be deployed broadly and have the benefit of scalability, though they may rely on scoring surface-level language use and mechanics (Zhang et al., 2013). Scoring models can also be trained for more specific and focused use. As such, AS model designs need to be considered in relation to their design, performance with respect to the gold standard of qualified human raters, and specific contexts of use (Powers et al., 2015). Shin and Gierl (2021) explored the performance of a traditional automated essay scoring model (i.e., a model using support vector machines with Coh-Metrix features) and a deep neural model (convolutional neural networks) for scoring. The deep neural model performed better overall, though with some difficulties on specific types of constructed-response test items. This approach has been shown to produce assessments that correlate more highly with human raters, based on quadratic-weighted kappa comparisons, than the correlation between Coh-Metrix approaches and human raters.

### *Assessment Purpose and Item Complexity*

Automated scoring—often of speaking and writing—can be used for a wide variety of purposes, including high-stakes purposes and formative feedback. This leads to varying levels of item complexity in the scoring process. For example, low complexity speaking items may require constrained or narrowed responses, or even reading from a script (Higgins et al., 2011). Conversely, open-constructed response items require AS scoring of unstructured, unrestricted, and spontaneous responses at different proficiency levels. Similarly, writing items may feature closed-item responses (cloze items, multiple choice, etc.) or open-constructed response items related to tasks, productions, or free responses (Hussein et al., 2019; Wang & von Davier, 2014), with the latter involving greater complexity. Examples of constructed response writing items include open-ended questions, short presentations, or short response interviews. Additionally, complex task-related items often involve multiple cognitive or psychological processes (reasoning, problem solving, arguing, etc.) and multifaceted output in terms of responses (Foltz et al., 2020). The increased complexity of constructed response items means there is a heightened need for quality assurance in terms of both AS validity and scoring capabilities (Chapelle et al., 2015; Wang & von Davier, 2014).

### *Stakes and Intended Use*

In terms of purpose, there are examples supporting diagnostic, high- and low-stakes assessment, and formative purposes (Aluthman, 2016; Attali, 2011; Chapelle et al., 2015). As such, AS can be used in a wide variety of contexts, both high- and low-stakes (Wood, 2020). However, as the stakes increase, so does the reciprocal responsibility of assessment validity and fairness of AS (Rupp et al., 2020; Williamson et al., 2012); the design standards and infrastructure supporting implementation in high-stakes contexts must be heightened (Wood, 2020).

Automated scoring and feedback can also be used to support teaching and learning. Aluthman (2016) investigated the impact on student essay writing development over a long-term period of pedagogical support featuring automated feedback and teacher mediation. Students improved mainly in writing mechanics, with modest improvements in grammar, usage, and style. The scoring model identified and sorted elements of writing, and then supported the process of learning by highlighting these for students and giving feedback as well as providing iterative support to teaching by informing the teacher about student writing development and common problems. In general, the granularity of the AS model analysis influences the feedback capabilities (DiCerbo et al., 2020). As a wide spectrum of granularity is afforded across AS models, consideration of need with respect to granularity is important when feedback is the primary desired outcome. More detailed and granular feedback capabilities have greater potential formative use.

While large scale and high stakes AS use has enjoyed significant attention and application since its inception, formative and educational use of AS scoring and feedback has recently increased (Foltz et al., 2020). This increase is largely due to advances in technology and AS design (Foltz et al., 2020; Rupp et al., 2020). Though the precise balance of AS standards for specific contexts differs, it raises important issues of AS design transparency and public conversation (Wood, 2020).

### *Features Scored*

The features of language scored among AS models differs significantly. In Wang (2021), a deep neural network model was created to model the feature values and to score speaking. A cutting-edge multidimensional feature extraction was performed on language recordings of test takers. Five categories of features were evaluated: pronunciation, fluency, vocabulary, grammar, and semantics. In Xi et al. (2012), two alternative automated speech scoring methods applied were compared: multiple regression and classification trees. The multiple regression model aligned more closely with the human scores and had greater construct relevance. In fact, the construct representation of the model was determined to meet the threshold needed for low-stakes test use of automated speech scoring. The speech scoring components included were automatic speech recognition, filters for flagging non-scorable responses, and linguistic measures of construct subdimensions, in addition to the two alternative scoring methods previously mentioned.

### *Improving Scorability*

Further, Wang (2021) introduces text cleaning after speech recognition and deep learning-based noise reduction to improve speech recognition and scoring accuracy. These and other technological implementations suggest new possibilities in terms of open oral grading. Likewise, Yoon and Zechner (2017) used flagging with automated speech scoring, as well as automated speech feature recognition. That is, difficult-to-score items were flagged by an AS filtering system (using baseline and extended filters) and then scored by human raters. As such, this is an AS model design feature. This significantly improved system scoring correlation with human raters.

### *Scoring Different Task Types*

Scoring of predictable and constrained spoken responses is well-established in the research and may have some advantages in terms of assessing speaking in and for specific constrained contexts and purposes (Litman et al., 2018). Tasks involving constrained assessment of speaking often include reading or production of an elicited response (Litman et al., 2018). Zechner et al. (2015) presented findings on successful AS of predictable and semi-predictable speech of speakers whose first language (L1) was not English. Cheng et al. (2015) investigated the effectiveness of a traditional Gaussian mixture model and a deep neural network hidden Markov model for acoustic modeling in educational applications of spoken assessment. The deep neural network significantly outperformed the traditional model. When comparing performance on open-ended and constrained tasks, the deep neural networks showed greater gains with the constrained tasks. Significant training data availability is needed for the deep neural network model training. Conversely, constrained spoken tasks require significantly less training data and have been proven reliable for constrained tasks.

### *Pronunciation*

Fu et al. (2020) introduced an automatic proficiency evaluation system for the evaluation of pronunciation by applying a scoring system that included various non-L1 English speaker acoustic models and L1 English speaker models (Gaussian mixture model, hidden Markov model, and deep

neural network). They then introduced a novel machine score called the reference-free error rate to evaluate English proficiency without a specific reference anchor. Overall, the deep neural networks outperformed the traditional acoustic models.

### *Summary of Automated Scoring Design Considerations*

In summary, the scoring model design of both speaking and writing has seen numerous advances. Traditional models have a proven fit for low-stakes assessment such as training, teaching, learning, and informal diagnostic assessment. Approaches leveraging cutting-edge technologies and scoring models (e.g., deep neural networks) appear to be nearing a tipping point of surpassing traditional models (e.g., Coh-Metrix) in both accuracy and viability for broad implementation. Nonetheless, the training data requirements, limitations on generalizability, and scaling still present challenges. Targeted and constrained use of traditional models still has significant utility. Hybrid artificial intelligence and human approaches may allow for controlled and strategic use of both established and cutting-edge AS models. Considering scoring model design, development, and implementation, as well as scoring model selection, a wide range of options are available. Still, stakeholders ought to choose wisely, based on their needs and capabilities (Williamson et al., 2012).

## Human Involvement in Scoring and Artificial Intelligence

### *Scoring Roles*

Attali et al. (2012) note the difficulties of machine scoring reliability when it comes to scoring complex and higher-order elements of writing. Moreover, their investigations into creating a hybrid approach with a division of focus—humans rating higher-order writing elements and the automated scoring model rating lower-order writing elements—highlighted the challenges of operationalizing hybrid approaches. As their investigation piloting a variety of hybrid-scoring model adjustments aimed at enhancing synergy between human raters and AS discovered, even slight changes can create unintended scoring imbalances. Human and automated essay rater scores using general scoring models are highly related on average and are similar across most subgroups. Additionally, operational policies and design can mitigate the impact of differences between human and machine raters reflected in reported scores (Bridgman et al., 2012b). Importantly, neither human raters nor automated writing scoring models perform without variation when applied broadly (Zhang et al., 2013). This suggests both limits on complexity in terms of generalizability and the important role of quality assurance and quality control in the scoring of writing. This last point is raised by Wang and von Davier (2014), who investigated methods for monitoring the scoring of written constructed responses by both human raters and AS models. They emphasized the need for monitoring the quality of scoring by both human raters and AS models across time, programs, and contexts. Wind et al. (2018) detailed the importance of considering and controlling how automated essay scoring models are trained using human ratings. This introduces yet another dynamic in AS—its human influence. Ultimately, it demonstrates that various problematic rater effects can be replicated by automated systems through the training process. As such,

AS model development and training must guard against undesirable rater effects during model design as well as quality assurance and quality control procedures.

In terms of rating speaking, human raters may yet enjoy some advantage in terms of their ability to evaluate more complex language elements (Bridgeman et al., 2012a). Automated speech scoring models (e.g., *SpeechRater*™) may be suitable for playing a role in reducing the burden, but, at least at this point, the role is complementary rather than replacing the need for any human rating. Zechner et al. (2017) presented research showing how when spoken responses were analyzed using an AS system, it was the part-of-speech element that correlated most closely with human ratings rather than the clause or phrase element. In a hybrid approach, human raters can also play a troubleshooting role to handle problematic items that the automated system identifies as being difficult for AS systems to score (Yoon & Zechner, 2017; Zechner et al., 2015). This can reduce the cost and demands of human scoring-related labour due to the scaling effect of automating the scoring process. Wang et al. (2018) describe processes using charts and evaluation statistics to monitor and evaluate the scoring of constructed responses by both human raters and AS models. The statistical monitoring proved useful for identifying outlier test items, human raters, and AS results. Though overall AS correlation with human raters was shown, variation with specific items can be problematic, thus highlighting the need for monitoring of AS, test items, human raters, and ongoing operationalization. Wang (2021) presents research on state-of-the-art automated spoken scoring which eliminates the need for experts to manually label keywords prior to scoring. This is an example of increased AS model independence and automatization. Of course, these kinds of shifts, increasing the automatization of scoring and reducing the transparency of the scoring process, must also be carefully balanced with informing stakeholders and skeptics about the AS systems and processes. Otherwise, resistance to AS can make implementation, use, adoption, and innovation challenging (Wood, 2020).

### *Summary of Human Involvement in Scoring and Artificial Intelligence*

At present, the roles of human scorers, automated scoring models, test takers, learners, and teachers conform to a variety of patterns and dynamics based on scoring design, technology, and implementation in the assessment of both writing and speaking. These roles are changing rapidly, with automation's roles increasing at a pace commensurate with its new capabilities. Nonetheless, the idea that automated scoring occurs devoid of human involvement or influence is erroneous. At present, there appears to be a strong case for the strategic use of hybrid approaches in some cases.

## Accuracy of Automated Scoring with Different Groups and Uses

### *Population Variation*

Attali (2011) presents research detailing how an automated essay scoring system (i.e., *e-rater*™) that considers word choice, grammatical conventions within sentences, and fluency has been shown to be stable across major language groups. This is an important consideration for AS models that are intended to be used in large-scale testing and with diverse populations. Zhang et al. (2013) found that population factors can influence the scoring of some items scored by both humans and AS, though in

general, there is broad cross-population stability. In the case of AS, it seems that it can sometimes replicate human-rater variations in judgment. Using AS systems with diverse populations implies that the AS results of subgroups within these populations should show equal agreement with human raters for these subgroups (Yan & Bridgeman, 2020).

However, some construct-irrelevant linguistic and culture-related stylistic elements (e.g., shell language, discourse development or linearity, etc.) may have a minor, yet not insignificant, influence on scoring done by both AS and human raters (Bridgeman et al., 2012b; Yan & Bridgeman, 2020). Population variation in this section refers to differences of L1, gender, ethnicity, and country that may create minor effects—depending on AS design elements and test items—both when comparing different national populations and specific subgroups within countries (Bridgeman et al., 2012b; Zhang et al., 2013). Training automated systems with scoring data tuned to specific target test populations and languages can alleviate some of the problematic effects (Bridgeman et al., 2012b).

An example of human-rater variation by population provided by Zhang et al. (2013) is that the amount of shell language used in essays may be valued differently by different human raters based on their own writing feature expectations. Shell language is a general and non-specific sequence of words used in persuasive writing or speech to advance and frame an argument. The general nature of the word sequence allows it to be plugged into a wide range of persuasive contexts without direct construct relevance, whilst also increasing the overall wordiness of the language produced (Bejar et al., 2013). Depending on the scoring model and approach, wordiness and use of shell language may be valued differently. Moreover, different populations may be more or less likely to use shell language in essays, thus leading to variation in rating on some test items. These kinds of differences must be monitored and considered when using AS of writing broadly (Bridgeman et al., 2012b; Schneider & Boyer, 2020). Training data for AS come from specific populations or groups at specific points in time and the judgments these automatic scorings produce reflect this influence. As such, it is necessary to monitor AS for invariance, drift, and anomalies (Wang & von Davier, 2014). Fundamentally, AS of writing needs to fit the scoring demands of the context of use during model development or selection, training, and implementation. Without attention to these details, AS of writing is more vulnerable to variation effects.

### *Automated Scoring Fit to Populations and Contexts*

Fu et al. (2020) introduce research detailing the challenges of assessing the pronunciation element in the speech of non-L1 English speakers. They used both L1 English and non-L1 English pronunciation models. Insufficient training of automatic speech scoring models on diverse pronunciation aspects of speech can limit the capabilities and generalizability of the models (Fu et al., 2020). Cheng et al. (2015) demonstrated a high level of scoring model performance using deep neural network-based scoring models and diverse speech production groups (e.g., children, adults, non-L1 English speakers, and L1 English speakers). Their investigations found that deep neural networks (DNN) outperformed a traditional AS model and that the word error recognition rate was significantly reduced, even when testing populations with significant variability. Test populations with significant variability in spoken language (children, non-native speakers of the language being tested, etc.) pose

challenges for AS and can result in word-recognition errors. A key point also noted in this investigation was the importance of the training data in DNN performance. DNN performance improves significantly with greater access to training data. Though the scoring of both constrained and open responses see improvement, open responses benefit most. Zechner et al. (2017) explore how to best evaluate syntactic competence on non-L1 English speakers using automation. They emphasize syntactic competence as being a key element of adept communication. Overall, these points suggest that using a scoring model within a specific domain or context may lend itself to more accurate scoring of constrained and predictable patterns of syntactic language use with a relatively predictable test-taking population (DiCerbo, 2020).

### *Summary of Accuracy of Automated Scoring with Different Groups and Uses*

When compared to the scoring of writing, the scoring of speaking involves an additional challenge of correctly deciphering spoken utterances. This sometimes results in assessments constraining the language in tasks to expected and known patterns. Errors in transcribing the spoken language or limitations of AS judgment—based on training limitations, AS model design, or operational policies—pose real challenges for the automatic scoring of speech, and especially for unconstrained production from broad test-taking populations or specific populations that the model is not tuned to (D'Mello, 2020). Nevertheless, when mobilized with a targeted and constrained assessment focus and paired with careful AS model selection and policies, various elements of speech can be automatically scored in a reliable manner. The extent to which this can be fairly done with all language groups and users as well as with specific language groups and users is a critical question in the automatic assessment of speech at scale.

## Automated Scoring Implementations for Assessment, Teaching, and Learning

### Large-Scale and High-Stakes Testing

Given that some of the main forces behind the drive to use AS are the desire to reduce human labour costs, increase test security, and mobilize testing on a large scale, AS generalizability and validity—especially validity across populations—are critical considerations. This emphasizes the importance of AS model training. At present, state-of-the-art AS models require significant training data. Moreover, with high-stakes testing, the need for validity demands the highest level of AS quality assurance and quality control (Ricker-Pedley et al., 2020; Shaw et al., 2020). This high degree of quality assurance and control requires significant expertise in AS and language testing. As such, though cutting-edge AS appears to be on the cusp of being able to fulfill this large-scale and high-stakes testing promise, it still faces some critical hurdles. High-stakes AS testing may result in life-changing effects for test takers (program admissions, professional certification, immigration status, etc.), which underscores the importance of ensuring assessment language construct and feature validity as well as assessment security (Schmidgall & Powers, 2017). Examples of high-stakes AS of language include Test of English as a Foreign Language Computer-Based Test and Internet-Based Test, International

English Language Testing System, and Pearson Test of English Academic (Schmidgall & Powers, 2017).

The research presented in the previous sections suggests that though correlation with expert human raters is promising for technologically advanced AS, more testing and development is required to reach the threshold for cost-effective and high-quality testing that is appropriate for high stakes use on a large scale. Conversely, more traditional and established AS approaches have comparative limitations in terms of correlation with expert human raters, generalizability, and ability to handle language complexity. Less training data are required, but more human involvement is often needed.

The literature reviewed above emphasized the importance of communicating AS details and purposes to stakeholders in an accessible manner. As automated scoring is increasingly implemented in the context of high-stakes testing, this becomes more and more important (Wood, 2020). Without the buy-in of stakeholders, AS using both traditional and more cutting-edge methods may face resistance that could limit its development and potential.

### Low-Stakes and Targeted Testing Within Specific Domains

In low-stakes contexts, AS has been used in practice tests, formative training, and for educational purposes in and out of classrooms (Foltz et al., 2020; Rupp et al., 2020; Shermis & Burstein, 2013). Research suggests that in contexts of targeted and known domains with semi-predictable language use, traditional AS, especially when paired with human raters in hybrid scoring approaches, have enough support to justify thoughtful implementation. These require smaller training sets than more cutting-edge AS models and it can be easier to design the assessment for specific populations. Moreover, specific language use can be targeted within the domain. This has benefits for focusing the AS model, accurately reflecting valid constructs of language use, and predicting language output. In this context, AS use for low-stakes assessment and training can be sufficiently accurate, cost-effective, and scalable for broad specific use within domains. With reduced stakes, the validity threshold can also be lowered somewhat since the purpose of the AS has less potential negative impact on user outcomes within the context of AS use.

### Formative Feedback for Teaching and Learning

This research literature shows that both writing and speaking feedback stemming from traditional AS can be used for pedagogical purposes. The feedback capabilities of an AS system depend not only on building feedback into the design, but also on the level of fine-grained analysis and detail in the design (DiCerbo et al., 2020). This is significant as it is an important AS design consideration if feedback is to be effectively transferred to support teaching and learning.

Teacher-mediated use could involve long-term monitoring of student development and needs, as well as integrated pedagogical use. While there may be limitations in terms of the language focus and complexity that the feedback can target, it nonetheless has a well-established history of practical and valid use.

Teacher-unmediated use of AS feedback also has demonstrated usefulness as a learning support (Burstein et al., 2021; Fu et al., 2020). Though it is not a "magic bullet" capable of replacing teacher mediation, it does have an established footing as a language learning support element that is operational at a very broad scale (Loewen et al., 2019). Automated scoring feedback for independent learning offers some interesting possibilities related to both traditional AS approaches and more state-of-the-art approaches. Given the pandemic-related assessment, teaching, and learning challenges, ways to mobilize AS feedback and remote learning access ought to be actively pursued.

## Future Research on Automated Scoring of Speaking and Writing

### Formative Purposes and Narrow Context of Language Use and Proficiency

As was briefly discussed in the previous subsection, AS can play a formative role in teaching and learning. More research on the long-term impact of AS implementation for formative language learning purposes, especially with state-of-the-art AS models, is needed. The case for AS usefulness in this context is well-established, but further exploration of teaching and learning would help to refine the implementation. This should include use in both synchronous and asynchronous teaching contexts, remote teacher-mediated contexts, and remote teacher-unmediated contexts. Providing iterative feedback and support based on ongoing AS model judgments may offer significant social benefits in terms of both teaching and learning. Additionally, cutting-edge AS use opens doors to the leveraging of metadata for teaching and learning and feedback on more complex language elements. Of course, this also heightens the fiduciary duty of AS developers and requires proactive outreach related to informing stakeholders and operationalizing AS approaches with appropriate transparency.

### Domain-Specific and Population-Specific Automated Scoring

More research on tailored AS models for specific domains and populations is also needed. Using both traditional and cutting-edge AS models, targeting AS model training and development for specific populations and contexts can increase validity and fairness. That is, fairness is increased by accounting for specific predicted populations of users and possible outlier users (e.g., those with different language, culture, or digital literacy). Validity is increased by selecting language constructs that are appropriate for specific domains. In both cases, AS models may benefit from being trained on data sets that closely resemble the future participants in terms of language production. This has an additional potential benefit of including practical domain information that may be relevant to academic or professional competencies. For example, an AS approach for nurses might feature the inclusion of tasks featuring relevant writing conventions or verbally relaying general health-related information. This type of tailored AS development also happens to be a good candidate for formative AS mobilization. As mentioned previously, domain-specific AS applications for formative learning may allow for the harvesting of informative metadata that could further deepen our understanding of the language learning process and the role of AS-based feedback.

## Next Steps

Automated scoring technological capabilities continue to grow, as does our understanding of how to implement them effectively in language assessment and testing. Automated scoring of speaking and writing, the productive language skills, have shown significant development. These language skills are critical for social and professional engagement in today's increasingly globalized world. With this in mind, it is important to consider the future role AS will play in Canadian society. Providing increased access to cost-effective, efficient, and reliable language assessment, teaching, and learning is of paramount importance. Remote AS assessment, teaching, and learning options not only lead to increased access, both generally and considering specific pandemic-related challenges, but also reduce costs and service bottlenecks. Reducing assessment bottlenecks whilst providing accessible teaching and learning supports can facilitate increased accreditation of internationally trained professionals and increase their participation in Canadian society. Language proficiency appropriate for the Canadian context is critical for professional success and related language proficiency limitations have been identified as a significant barrier for internationally trained professionals in Canada (Kaushik & Drolet, 2018). Barriers to professional accreditation have negative effects on both the individuals, who are at risk of being marginalized, and Canadian society, which is both in dire need of skilled labour and increased socioeconomic inclusion of marginalized people (Kaushik & Drolet, 2018). Automated scoring is poised to play an important role in overcoming these challenges. It is starting to hit its stride and will continue to gain speed based on new technologies, new applications, and new research.

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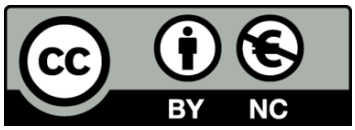

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# Student Perceptions of the Visual Design of Learning Management Systems

# Perceptions des étudiants à l'égard de la conception visuelle des systèmes de gestion de l'apprentissage

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## Abstract

Research on the impact of the visual design of the user interface of learning management systems (LMS) on learning experience is sparse. The purpose of this study was to conduct a preliminary examination of students' perceptions of the visual design of their postsecondary institutions' LMS and their learning experiences using survey methodology ($N = 46$). Students generally agreed that the course homepages were well organized and that the LMS colours, while deemed moderately to very important, did not enhance learning or increase the ability to remember course content. However, more positive perceptions of the visual appearance of the LMS were associated with greater satisfaction with grades. Expected end of term grade point average was negatively correlated with the degree to which students perceived that colour enhanced their learning. Students reported a greater satisfaction with the contribution of the LMS to learning correlated to the number of school terms they had used an LMS, their LMS proficiency, and their perceptions about the visual appeal of the LMS design. Together, these results suggest that exploring the impact of LMS colour and other dimensions of visual design on student engagement and learning are important and have practical value for LMS developers, instructional designers, and instructors.

*Keywords*: Colour; Learning management system; Online education; Technology; Visual design; Visual perception

## Résumé

Les recherches sur l'impact de la conception visuelle de l'interface utilisateur des systèmes de gestion de l'apprentissage (SGA) sur l'expérience d'apprentissage sont rares. Le but de cette étude était d'effectuer un examen préliminaire des perceptions des étudiants à l'égard de la conception visuelle du

SGA de leur établissement postsecondaire et de leurs expériences d'apprentissage à l'aide d'une technique d'enquête ($N = 46$). Les étudiants ont généralement convenu que les pages d'accueil du cours étaient bien organisées et que les couleurs du SGA, bien que considérées comme modérément à très importantes, n'amélioraient pas l'apprentissage ou n'augmentaient pas la capacité de se souvenir du contenu du cours. Cependant, des perceptions plus positives de l'aspect visuel du SGA ont été associées à une plus grande satisfaction à l'égard des notes. La moyenne pondérée cumulative prévue de fin de session était négativement corrélée avec la mesure dans laquelle les étudiants percevaient que la couleur améliorait leur apprentissage. Les étudiants ont déclaré être plus satisfaits de la contribution du SGA à l'apprentissage en corrélation avec le nombre de sessions universitaires qu'ils avaient utilisés un SGA, leur maîtrise du SGA et leurs perceptions de l'attrait visuel de la conception du SGA. Dans l'ensemble, ces résultats suggèrent que l'exploration de l'impact de la couleur du SGA et d'autres dimensions de la conception visuelle sur l'engagement et l'apprentissage des étudiants est importante et a une valeur pratique pour les développeurs de SGA, les concepteurs pédagogiques et les instructeurs.

*Mots-clés* : Couleur ; Système de gestion de l'apprentissage ; Éducation en ligne ; Technologie ; Conception visuelle ; Perception visuelle

## Introduction

Approximately 2,183,973 individuals were enrolled in courses at Canadian postsecondary institutions in the 2019-2020 academic year (Statistics Canada, 2022). Before the COVID-19 pandemic, an estimated 30% of students were completing online courses (EduConsillium, 2015), but at the height of the pandemic, 92% of students were taking at least one course online (Doreleyers & Knighton, 2020). Moreover, many courses with face-to-face instruction are typically supplemented with online components (e.g., availability of learning resources and assessments on course websites or LMSn). Thus, the development of effective e-learning technologies is important for postsecondary institutions and the large numbers of students and faculty who use them. Previous research has examined the potential value of online learning by asking administrators (Bates et al., 2017) and faculty (Schönwetter & Reynolds, 2013) about their perspectives and barriers to use. Few studies, however, have detailed postsecondary students' perspectives of online learning and even fewer have asked them about their perspectives of the visual design of the LMS they are required to use. The primary goal of this study was to examine students' perceptions of the visual design of the LMS and how these perceptions related to learning experiences, engagement, and achievement outcomes using survey methodology.

## Background

Online learning has been defined as learning facilitated by technology (specifically via an LMS) in which students interact with instructors synchronously or asynchronously and where the location of study is not dependent on a particular location (Singh & Thurman, 2019). Advancements in technology associated with online learning enabled postsecondary institutions to pivot their course offerings from

face-to-face to remote teaching and rapid learning in response to the COVID-19 pandemic. Prior to the pandemic, online education was already growing rapidly and was due, in part, to interest in enhancing learning outcomes and coping with decreases in resources allocated to teaching and learning in higher education (Farinella et al., 2000).

Some researchers have shown that students enrolled in online courses have better outcomes in numerous areas, such as understanding the course structure, communication with instructors, increased engagement and satisfaction with course material, and higher final grades, compared to face-to-face courses (Panigrahi et al., 2018; Pei & Wu, 2019; Soffer & Nachmias, 2018). Students have reported appreciation of the flexibility and convenience of online learning (Sanford et al., 2017; Song et al., 2004) and the deeper reflection that is often required prior to engaging in learning activities (Dumford & Miller, 2018). Students have also valued online courses as they are often more student-centered than traditional face-to-face lecture-based courses (Petrides, 2002; Richardson et al., 2017) as well as offering unique opportunities for instructor-student and student-student engagement (Martin & Bolliger, 2018).

Despite the documented strengths of online learning, students have reported that delays in feedback from other students and instructors (Petrides, 2002), lack of community and feelings of isolation (Kebritchi et al., 2017; Vanslambrouck et al., 2018; Vonderwell, 2003), and technological problems are limitations of online learning (Rasheed et al., 2020; Song et al., 2004). Students' levels of online learning readiness, specifically their online learning efficacy or the belief in the effectiveness of online learning vs traditional face-to-face learning, may also influence their learning outcomes significantly (Joosten & Cusatis, 2020). Moreover, instructor attitudes and dispositions toward the online modality (Cutri & Mena, 2020; Los et al., 2021) emphasized by the technological and pedagogical challenges and adaptations often necessitated by the online modality (e.g., teaching styles, time management, and content development) (Kebritchi et al., 2017) may have an impact on student perceptions of the effectiveness of online learning. Lastly, when instructors use features of the LMS to enhance the visual design of the LMS and the learning materials, students are more likely to engage with the LMS, resulting in positive benefits to their learning (Ghapanchi et al., 2020).

Visual design of a product/interface encompasses both functionality and aesthetics. Effective designs require that designers consider the nature of the users, how users will interact with the product, and other variables that influence user experience (Bader & Lowenthal, 2018). Functionality and aesthetics are viewed as intertwined yet aesthetics can sometimes be regarded as less important in online teaching and learning spaces. Aesthetics may be lower priority for some LMS developers because this aspect of design is a "wicked problem". Such problems are difficult to define, solutions cannot be tested immediately, many solutions are possible, and each solution is uniquely experienced by each user (Ritter & Webber, 1973). Without paying attention to the visual aspects of LMS interfaces, however, "LMS designs become impersonal, insipid, and uninspiring" to the learner and the instructor (Bader & Lowenthal, 2018, p. 28). Such impressions could lead to lack of satisfaction and a downward trend in the use of an LMS by teachers and learners.

Of relevance to the present study is the research examining the impact of visual complexity on students' online learning experiences. Poor visual design (including inappropriate degree of visual complexity and colourfulness) can overload learners' cognitive resources resulting in disorientation and reduced learning (Christianson, 1992; Eveland Jr. & Dunwoody, 2001; Sharp et al., 2017). Stoesz et al. (2020) reported negative correlations between a measure of working memory capacity (i.e., Digit Span subtest of the Wechsler Adult Intelligence Scale, Fourth Edition; Wechsler, 2008) and participants' ratings of the visual complexity of LMS images. These findings suggested that limiting the quantity of information and simplifying structure and colour when designing LMS interfaces and subject-matter content are important. There were two limitations in this work, however. Stoesz et al. had examined the relationship between subjective complexity ratings of LMS images and working memory capacity in a laboratory setting; further, the participants may have had limited experience with the various LMS' that were presented to them. In addition, Stoesz et al. did not examine whether students perceived LMS colour and other visual design dimensions as facilitators of or barriers to their learning.

The presence of colour information supports encoding and retrieval processes (Cortese et al., 2019; Dzulkifli & Mustafar, 2013; Gegenfurtner & Rieger, 2000). Using a delayed match-to-sample task, Gegenfurtner and Rieger (2000) found that recognition accuracy was higher for color images than for luminance-matched black and white images of natural scenes that were presented to participants for very brief durations. The authors attributed this finding to the "enriched representation of the colour images in short-term memory" (p. 806), meaning that colour provided viewers with additional sensory cues that might be useful later when the images need to be remembered. Colours also draw attention and generate emotional responses (e.g., enjoyment, satisfaction, frustration), thereby enhancing (or impeding) learning (Ashrafi et al., 2020; Tharangie et al., 2008). Positive perceptions of LMS presentation and navigation (e.g., graphic design, colour, and layout) also appeared to be associated with the perceived usefulness of the LMS, which in turn may be a significant predictor of the intention to continue to use the LMS (Ashrafi et al., 2020).

## Present Study

The purpose of this study was to examine students' perceptions of the visual design of the LMS vis-à-vis their learning engagement and achievement outcomes, using survey methodology. We were particularly interested in exploring the relationships between educational experience (e.g., terms or years of experience using an LMS), familiarity and satisfaction with an LMS, visual design (including colour) of the LMS, and satisfaction with the learning experience. The findings contribute to knowledge of the students' perceptions of the importance of the design of online teaching and learning environments considering their overall learning experiences in Canadian postsecondary institutions.

# Method

## Participants

Participants enrolled at postsecondary educational institutions across Canada were eligible to take part in this study. Recruitment through various Canadian students' associations was attempted, however, only one association agreed to distribute the study information to its members. Thus, social media advertisement in Canada and snowball sampling were also employed as recruitment strategies. Snowball sampling involved distributing the study information (including the link to the survey) via an email contact list maintained by the first author. Contacts included collaborators, educators, and previous research participants who had consented to be contacted for opportunities to take part in future studies. These contacts were asked to share the recruitment email. Clicking on the link in the email directed students to the online survey administered via Qualtrics. The study protocol was approved by the research ethics board at the University of Manitoba and from several other postsecondary institutions across Canada.

## Materials and Procedure

We developed the four-section *Use and Perceptions of Learning Management Systems Survey* adapting items from the literature focused on online learning and web usability (Lavie & Tractinsky, 2004; Schönwetter & Reynolds, 2013; Waheed et al., 2016). We have formal training and practical experience in teaching and learning, online learning, and LMS implementation, training others to use the LMS, and examining user experiences. As such, items were selected by the first two authors for the present study based on each item's face validity. Each of the four sections of the survey are described below.

The *General Use of Your LMS* section consisted of 7 items about routine use of the LMS (e.g., *How many terms have you used the LMS?*) and 12 items designed to collect information about the ability to perform certain tasks within the LMS rated on a 5-point scale (1 = *Never tried*, 2 = *Not at all*, 3 = *Not very easily*, 4 = *Somewhat easily*, 5 = *Very easily*). Responses to the latter 12 items were summed to produce *LMS Proficiency* scores (Range = 12 – 60), with scores ≥ 48 indicating ability to perform more tasks within the LMS with ease. The Cronbach's alpha for the 12 items in the LMS Proficiency subscale was .76.

The *Perceptions of the Visual Design of Your LMS* section assessed perceptions of the LMS' visual appearance (11 items) and the influence of colours on learning (5 items), rated on a 7-point scale (1 = *Strongly disagree* to 7 = *Strongly agree*); and the importance of LMS design dimensions to the learning experience (8 items), rated on a 5-point scale (1 = *Not important at all*, 2 = *Of little importance*, 3 = *Of average importance*, 4 = *Very important*, 5 = *Absolutely essential*). Items in each of these three areas were first reverse scored (if necessary) then summed to produce three scores: *Perceptions of Visual Appearance* (Range: 11 – 77), *Colours' Influence on Learning* (Range: 5 – 35); and *Importance of Visual Design* (Range: 8 – 40). Higher scores on these measures suggest that visual

appearance of the LMS is pleasing, colours have a greater influence on learning, and visual design dimensions are important to the learning experience. Cronbach's α for each of these three subscales was .88, .90, and .54, respectively.

The *LMS Learning Experience* section consisted of items about the satisfaction and importance of the LMS to learning and overall learning experiences (after Deng & Poole, 2010; Eristi et al., 2010; Palmer & Hold, 2010). Fourteen items asked students to rate on a 7-point scale (1 = *Extremely dissatisfied* to 7 = *Extremely satisfied*, or 0 = *Not applicable*) their level of satisfaction of the contribution of various LMS features (e.g., accessing course materials, viewing grades) to their learning. Responses to these items were summed to produce *Contribution of LMS to Learning* scores (Range: 0 – 98), with higher scores reflecting greater satisfaction with more features of the LMS and the contribution of these features to learning. Thirteen items asked students to rate their agreement on items related to engagement with and flexibility of the LMS (i.e., "My institution's LMS is engaging," "I can decide where I want to learn when using my institution's LMS (e.g., at home, on campus)") on a 7-point scale (1 = *Strongly disagree* to 7 = *Strongly Agree*). Responses to these 13 items were summed to produce *LMS Engagement and Flexibility* scores (Range: 13 – 91), with higher scores reflecting greater engagement with and perceptions of flexibility associated with the LMS. Cronbach's α for the LMS Learning Experience, Contribution of LMS to Learning, and LMS Engagement and Flexibility subscales were .84, .84, and .79, respectively.

Items in the *General Information* section collected participant age, gender, and cultural and educational background. Participants also indicated their expected grade point average (GPA) at the end of the current term [0.0 (0 - 49%) to 4.5 (90 - 100%)] and their level of satisfaction with their grades (1 = *Extremely dissatisfied* to 7 = *Extremely satisfied*).

A pilot survey was administered to 10 university students recruited through our participant registry. Pilot survey participants were invited to the laboratory to take part in a think aloud procedure as they completed the online survey. They received $10 gift cards for taking part in the pilot survey. Based on their verbalized responses and reasons for their responses, minor changes to the survey (e.g., rephrasing of questions or instructions) were made to improve clarity.

### Data Analysis

SPSS Version 27 was used for data analysis. Descriptive statistics (frequency, median [*Mdn*], range) and non-parametric (Spearman Rho) correlations were computed.

## Results

### Participant Characteristics

Between June 20 and October 20, 2020, 46 students participated in the online survey study (Table 1). Thirty participants reported an expected end of term GPA (*Mdn* = 4.0, *Range* = 2.5 – 4.5).

**Table 1**

*Participant Characteristics*

| Variable | *n* | % |
|---|---|---|
| Age (years) | 25 | 100.0 |
| < 21 | 12 | 48.0 |
| 21+ | 13 | 52.0 |
| Sex | 32 | 100.0 |
| Male | 15 | 46.9 |
| Female | 17 | 53.1 |
| Location of elementary and secondary education | 32 | 100.0 |
| In Canada | 28 | 87.5 |
| Outside of North America | 4 | 12.5 |
| Location of postsecondary institution | 32 | 100.0 |
| Manitoba | 27 | 84.4 |
| Other Canadian provinces | 5 | 15.6 |
| Years of postsecondary completed | 37 | 100.0 |
| < 1 | 9 | 4.3 |
| 1-2 | 10 | 27.0 |
| 3-5 | 5 | 13.5 |
| 6+ | 8 | 1.6 |

## Use and Perceptions of Learning Management Systems Survey

### *General LMS Use and Expertise*

Thirty-four (89.5%) respondents reported that D2L Brightspace was their institutions' LMS and four (10.5%) did not know. Twelve (32.4%) respondents indicated having used their institutions' LMS for one or two terms and 25 (67.6%) reported three or more terms of LMS use. As this study was completed prior to the COVID-19 pandemic, it is not surprising that most respondents ($n$ = 23, 60.5%) reported not being enrolled in any strictly online courses during the regular academic year and most ($n$ = 34, 91.9%) were enrolled in at least one face-to-face course.

Respondents reported logging on to their LMS at least 1 to 4 times per day ($n$ = 7, 18.9%), 5 or 6 times per day ($n$ = 7, 18.9%), and 7 or more times per day ($n$ = 23, 62.2%). Respondents indicated

that they could easily login to the LMS ($n$ = 37, 97.3%), upload an assignment file to a submission folder ($n$ = 30, 81.0%), and navigate from one course to another ($n$ = 35, 94.6%). There were also respondents who had never tried sending messages to other students using the email or chat tools (48.6%), setting up automatic notification (32.4%), or using the calendar tool (35.1%) (Table 2

).

As expected, *LMS Proficiency* scores (*Mdn* = 43, *Range* = 28 – 60) were correlated with the number of terms of LMS use [$r_s(34) = .44$, $p = .007$] and years enrolled in postsecondary education [$r_s(30) = .38$, $p = .03$], suggesting that more opportunities to experience educational technology increase competence for its use. *LMS Proficiency* scores were not correlated with expected end of term GPA [$r_s(28) = .10$, $p = .60$] or satisfaction with grades [$r_s(30) = -.10$, $p = .94$].

**Table 2**

*Frequencies of Responses to Items Assessing LMS Expertise (n = 37)*

| *I can . . .* | Never tried | | Not at all | | Not very easily | | Somewhat easily | | Very easily | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| **login to the LMS** | 0 | - | 0 | - | 1 | 2.7 | **6** | **16.2** | **30** | **81.1** |
| post to a discussion board | 8 | 21.6 | 0 | - | 4 | 10.8 | 15 | 40.5 | 10 | 27.0 |
| **upload an assignment file to a submission folder** | 5 | 13.5 | 0 | - | 2 | 5.4 | **17** | **45.9** | **13** | **35.1** |
| **navigate from one course to another** | 0 | - | 0 | - | 2 | 5.4 | **9** | **24.3** | **26** | **70.3** |
| send a message to another student using the email tool | 11 | 29.7 | 1 | 2.7 | 6 | 16.2 | 10 | 27.0 | 9 | 24.3 |
| send a message to another student using the chat tool | 18 | 48.6 | 2 | 5.4 | 8 | 21.6 | 4 | 10.8 | 5 | 13.5 |
| check my grades | 6 | 16.2 | 1 | 2.7 | 5 | 13.5 | 8 | 21.6 | 17 | 45.9 |
| take a quiz | 7 | 18.9 | 0 | - | 2 | 5.4 | 10 | 27.0 | 18 | 48.6 |
| find specific course materials/content | 0 | - | 0 | - | 8 | 21.6 | 14 | 37.8 | 15 | 40.5 |
| set up automatic notifications | 12 | 32.4 | 4 | 10.8 | 6 | 16.2 | 7 | 18.9 | 8 | 21.6 |
| use the calendar tool | 13 | 35.1 | 4 | 10.8 | 8 | 21.6 | 6 | 16.2 | 6 | 16.2 |

| *I can . . .* | Never tried | | Not at all | | Not very easily | | Somewhat easily | | Very easily | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| review assignment feedback provided by an instructor | 5 | 13.5 | 0 | - | 7 | 18.9 | 14 | 37.8 | 11 | 29.7 |

*Note*. Bolded entries indicate the three LMS activities that most respondents could complete easily.

### *Learning Management System Visual Design*

Respondents agreed that the LMS course homepages were organized (75.0 %), not too colourful (66.7%), and clean (75.0 %), and that colours did not enhance their learning experiences (70.6%), did not help them to learn (80%), or increase their ability to remember course material (70.0%) ( Table 3).

**Table 3**

*Frequencies of Responses to Items Assessing Perceptions of the Visual Design of the LMS (n = 36)*

| *I can . . .* | Never tried | | Not at all | | Not very easily | | Somewhat easily | | Very easily | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| **login to the LMS** | 0 | - | 0 | - | 1 | 2.7 | **6** | **16.2** | **30** | **81.1** |
| post to a discussion board | 8 | 21.6 | 0 | - | 4 | 10.8 | 15 | 40.5 | 10 | 27.0 |
| **upload an assignment file to a submission folder** | 5 | 13.5 | 0 | - | 2 | 5.4 | **17** | **45.9** | **13** | **35.1** |
| **navigate from one course to another** | 0 | - | 0 | - | 2 | 5.4 | **9** | **24.3** | **26** | **70.3** |
| send a message to another student using the email tool | 11 | 29.7 | 1 | 2.7 | 6 | 16.2 | 10 | 27.0 | 9 | 24.3 |
| send a message to another student using the chat tool | 18 | 48.6 | 2 | 5.4 | 8 | 21.6 | 4 | 10.8 | 5 | 13.5 |
| check my grades | 6 | 16.2 | 1 | 2.7 | 5 | 13.5 | 8 | 21.6 | 17 | 45.9 |
| take a quiz | 7 | 18.9 | 0 | - | 2 | 5.4 | 10 | 27.0 | 18 | 48.6 |
| find specific course materials/content | 0 | - | 0 | - | 8 | 21.6 | 14 | 37.8 | 15 | 40.5 |

| *I can . . .* | Never tried | | Not at all | | Not very easily | | Somewhat easily | | Very easily | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| set up automatic notifications | 12 | 32.4 | 4 | 10.8 | 6 | 16.2 | 7 | 18.9 | 8 | 21.6 |
| use the calendar tool | 13 | 35.1 | 4 | 10.8 | 8 | 21.6 | 6 | 16.2 | 6 | 16.2 |
| review assignment feedback provided by an instructor | 5 | 13.5 | 0 | - | 7 | 18.9 | 14 | 37.8 | 11 | 29.7 |

*Note.* The responses Strongly disagree, Disagree, and Somewhat disagree were collapsed into the category Disagree. The responses Strongly agree, Agree, and Somewhat agree were collapsed into the category Agree. Bolded entries indicate the three most common responses. *Items were reverse coded when creating Visual Appearance scores.

Although few respondents indicated that colour enhanced their learning experience, *Colours Influence on Learning* scores (*Mdn* = 20, *Range* = 9 – 28) were correlated positively with *Visual Appearance* scores (*Mdn* = 51.5, *Range* = 28 – 71) [$r_s(36) = .46$, $p = .005$] and negatively with expected end of term GPA [$r_s(28) = -.38$, $p = .04$]. The latter relationship was driven by a significant negative correlation between GPA and one item: "The colours in the LMS enhance my learning" [$r_s(28) = -.40$, $p = .03$]. *Visual Appearance* scores were not correlated with expected end of term GPA [$r_s(28) = .06$, $p = .75$].

When asked about the importance of the design dimensions to their learning experience, functionality, navigation, and page layout were viewed as very and extremely important (100%, 97.2%, and 88.9% of respondents, respectively), whereas most participants rated colour and animations as not at all important or slightly/moderately important (Table 4).

**Table 4**

*Frequencies of Responses to Items Assessing Perceived Importance of LMS Design Dimensions to Learning Experience (n = 36)*

| | Not at all important | | Slightly important | | Moderately important | | Very important | | Extremely important | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| **Page layout** | 1 | 2.8 | 0 | - | 3 | 8.3 | **22** | **61.1** | **10** | **27.8** |
| Colour | 10 | 27.8 | 11 | 30.6 | 12 | 33.3 | 3 | 8.3 | 0 | - |

| | Not at all important | | Slightly important | | Moderately important | | Very important | | Extremely important | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* | % | *n* | % |
| Typography | 0 | - | 7 | 19.4 | 10 | 27.8 | 16 | 44.4 | 3 | 8.3 |
| Visuals (tables, graphs, photographs) | 0 | - | 3 | 8.3 | 8 | 22.2 | 16 | 44.4 | 9 | 25.0 |
| Animations (videos, motion graphics, simulations) | 1 | 2.8 | 10 | 27.8 | 12 | 33.3 | 7 | 19.4 | 6 | 16.7 |
| **Navigation** | 0 | - | 0 | - | 1 | 2.8 | **9** | **25.0** | **26** | **72.2** |
| **Functionality** | 0 | - | 0 | - | 0 | - | **10** | **27.8** | **26** | **72.2** |
| Size of the area containing the course materials/content | 0 | - | 1 | 2.8 | 8 | 22.2 | 14 | 38.9 | 13 | 36.1 |

*Note.* Bolded entries indicate the three most common responses of Very and Extremely important.

### *Learning Management System Learning Experience*

Respondents were generally satisfied that accessing and interacting with course materials, completing quizzes/self-assessments, and submitting and receiving feedback on assignments contributed to their learning. Neutral or dissatisfied responses were common for items related to contacting peers via the LMS, the calendar, and the discussion tools. Fewer students were satisfied with the contribution of the LMS towards working collaboratively with peers (Table 5). *Contribution of LMS to Learning* scores (*Mdn* = 53, *Range* = 15 – 90) were positively correlated with the number of terms of LMS use [$r_s(32) = .34$, $p = .05$], *LMS Proficiency* [$r_s(33) = .47$, $p = .004$], and *Visual Appearance* scores [$r_s(33) = .40$, $p = .02$].

**Table 5**

*Frequencies of Responses to Items Assessing Satisfaction with the Contribution of the LMS to Learning Experiences (n = 35)*

| | Dissatisfied | | Neither satisfied nor dissatisfied | | Satisfied | | Not applicable |
|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* |
| **Accessing course materials** | 3 | 8.6 | 1 | 2.9 | **31** | **88.6** | 0 |
| Contacting others via internal LMS messaging (e.g., email, chat) | 5 | 14.3 | 7 | 20.0 | 14 | 40.0 | 9 |

| | Dissatisfied | | Neither satisfied nor dissatisfied | | Satisfied | | Not applicable |
|---|---|---|---|---|---|---|---|
| | *n* | % | *n* | % | *n* | % | *n* |
| Using the calendar tool | 10 | 28.6 | 10 | 28.6 | 3 | 8.6 | 12 |
| **Interacting with learning resources/ course materials/content** | 6 | 17.1 | 5 | 14.3 | **24** | **68.6** | 0 |
| Contributing to discussions | 8 | 22.9 | 6 | 17.1 | 14 | 40.0 | 7 |
| Reading other's contributions to discussions | 8 | 22.9 | 5 | 14.3 | 15 | 42.9 | 7 |
| Using the chat tool | 5 | 14.3 | 12 | 34.3 | 4 | 11.4 | 14 |
| Using the whiteboard tool | 2 | 5.7 | 8 | 22.9 | 2 | 5.7 | 23 |
| Working collaboratively in a group | 4 | 11.4 | 7 | 20.0 | 7 | 20.0 | 17 |
| **Completing quizzes/self-assessments** | 4 | 11.4 | 3 | 8.6 | **25** | **71.4** | 3 |
| **Submitting assignments** | 2 | 5.7 | 5 | 14.3 | **24** | **68.6** | 4 |
| Receiving feedback on assignments | 4 | 11.4 | 6 | 17.1 | 22 | 62.9 | 3 |
| **Viewing my grades** | 5 | 14.3 | 3 | 8.6 | **24** | **68.6** | 3 |
| Reviewing course progress | 7 | 20.0 | 8 | 22.9 | 18 | 51.4 | 2 |

*Note.* The responses Extremely, Moderately, and Slightly dissatisfied were collapsed into one category Dissatisfied. The responses Extremely, Moderately, and Slightly satisfied were collapsed into one category Satisfied. Bolded entries indicate the three most common "satisfactory" responses.

Most respondents also agreed with the statements, "I feel that my institution's LMS enhances my learning experience;" "I prefer when my instructor integrates the LMS as a large component of the course;" and "I can decide where I want to learn when using my institution's LMS (e.g., at home, on campus)" (Table 6). *LMS Engagement and Flexibility* scores were positively correlated with *Contribution of LMS to Learning* scores [$r_s(30) = .45$, $p = .01$] and *Visual Appearance* scores [$r_s(30) = .67$, $p < .001$]. *LMS Engagement and Flexibility* scores were not correlated with expected end of term GPA [$r_s(28) = -.24$, $p = .21$] or satisfaction with grades [$r_s(30) = .16$, $p = .39$]. Together, these results suggest that students appreciate the flexibility and accessibility to learning materials that learning technologies provide, despite the finding that their grades and satisfaction with their grades were not linked to their engagement nor perceived flexibility to learn when the LMS is utilized.

**Table 6**

*Frequencies of Responses to Items Assessing Engagement with and Flexibility of the LMS*

| | Disagree | | Agree | | |
|---|---|---|---|---|---|
| | *n* | % | *n* | % | *N* |
| I like to spend time browsing my institution's LMS. | 14 | 53.8 | 12 | 46.2 | 26 |
| I try to leave my institution's LMS as soon as possible.* | 13 | 54.2 | 11 | 45.8 | 24 |
| I avoid getting back to my institution's LMS after I have left it.* | 17 | 73.9 | 6 | 26.1 | 23 |
| I avoid any unplanned activity in my institution's LMS.* | 14 | 60.9 | 9 | 39.1 | 23 |
| I am satisfied with my institution's LMS. | 9 | 33.3 | 18 | 66.7 | 27 |
| **I feel that my institution's LMS enhances my learning experience.** | **9** | **31.0** | **20** | **69.0** | **29** |
| **I prefer when my instructor integrates the LMS as a large component of the course.** | **8** | **29.6** | **19** | **70.4** | **27** |
| I feel that my institution's LMS is engaging. | 9 | 39.1 | 14 | 60.9 | 23 |
| I feel that the information in my institution's LMS is incomplete. | 14 | 53.8 | 12 | 46.2 | 26 |
| I feel that working within my institution's LMS is frustrating.* | 16 | 61.5 | 10 | 38.5 | 26 |
| **I can decide where I want to learn when using my institution's LMS (e.g., at home, on campus).** | **4** | **14.3** | **24** | **85.7** | **28** |
| I use my institution's LMS because my activity is recorded, and usage can increase my final grade. | 19 | 76.0 | 6 | 24.0 | 25 |
| I can decide on the pace of my learning when using my institution’s LMS. | 9 | 34.6 | 17 | 65.4 | 26 |

*Note.* The responses Strongly disagree, Disagree, and Somewhat disagree were collapsed into one category Disagree. The responses Strongly agree, Agree, and Somewhat agree were collapsed into one category Agree. No responses were recorded for "Neutral". *Items were reverse coded when creating LMS Engagement and Flexibility scores. Bolded entries indicate the three statements where the most common responses were “Agree.”

## Discussion

The goals of the present study were to understand how postsecondary students use the LMS at their educational institutions, determine what students think about the visual design of the LMS and its ease of use, and describe students' perceptions of the effect that colour has on their learning. To meet these goals, we developed and implemented an online survey for students enrolled in Canadian postsecondary institutions. We found several interesting results related to visual design, including colour, which have not been previously reported to our knowledge. Specifically, we found that most students felt that the visual design of their LMS was aesthetically pleasing. The perception that colours influenced their learning was negatively correlated with end of term GPA; the perception that the LMS contributed positively to their learning was associated with several factors: greater proficiency with the LMS; perceptions of flexibility and engagement in learning when using an LMS and the visual appearance of their LMS. We discuss these findings in detail.

When asked about the importance of the design dimensions to their learning experience, respondents in our study indicated that navigation and functionality were extremely important, whereas colour and typography were viewed as moderately or slightly important. Further, respondents indicated that colours did not enhance their learning experience or increase their ability to remember course content. Interestingly, students who perceived that colours enhanced learning reported lower end of term GPA. These results are inconsistent with previous research showing that colour in teaching and learning activities enhances memory thereby increasing learning (Finn & McLachlan, 2010), and students often prefer the colour versions of learning materials over black and white or monochrome versions (see Pelet & Papadopoulou, 2011; Pert & Wilson, 1996 for reviews). For students with various levels of visual impairment, high colour contrast may not only be preferred but may be necessary for facilitating viewing and reading of learning materials. Indeed, it has been strongly recommended that instructional designers incorporate colour in ways that will enhance readability (see Mancilla & Frey, 2021).

The presence of colour (especially when used poorly) to emphasize information in learning materials, however, may create barriers for students with colour vision deficiencies (Klooster, 2016) and such use should be avoided (see Mancilla & Frey, 2021). Additional studies using survey and experimental methodology that involve postsecondary students with visual impairments, particularly colour blindness, are needed to improve our understanding of how the colour and complexity of the LMS and other learning materials impede or enhance task completion, recall, and higher order learning (e.g., analysis, synthesis). In the 2006 Participation and Activity Limitation Survey (PALS), a national survey of Canadians with activity limiting conditions, 5.4% (or 24,280) of the 5- to 64-year-olds surveyed were students with a visual impairment (Statistics Canada, 2009). Of these students, 32.9% reported that it took them longer to complete their programs of study and 34.5% discontinued their education. With increased LMS and other online educational tools, it is important to consider how students with conditions related to vision are impacted by the design of educational technologies.

Postsecondary students in our study who expected lower end of term grades were more likely to indicate that colours enhanced their learning experience. Why this would be the case is not clear; however, the literature on elementary school children may provide some insight. Hannus and Hyönä (1999) examined the effects of illustrations on learning content from textbooks among 10-year-old children. Recall and comprehension of text was enhanced for children with higher intellectual ability but not for children with lower intellectual ability. Further examination using eye-tracking technology revealed that children with higher intellectual ability divided their attention between narrative passages and illustrations more strategically than did those with lower intellectual ability. More colour also contributes to the complexity of an image (Michailidou et al., 2008; Reinecke et al., 2013; Stoesz et al., 2020). Stoesz et al. (2020) observed that participants who perceived screenshots of LMS interfaces as more complex also scored lower on a test of working memory capacity. For postsecondary students viewing course material within an LMS, colour may capture attention giving the impression of its importance but may not enhance learning especially when processing is not strategic. With further investigation, utilizing eye-tracking technology and assessing various participant characteristics may help to elucidate the nature of the observed association between lower GPA and the perception that the colour scheme of the LMS enhances learning.

For respondents to our survey, the perception that the LMS design was visually pleasing was associated with greater LMS use and proficiency, greater satisfaction that the LMS features contributed to learning, increased engagement with the LMS, and perceptions that the LMS allowed more flexibility. Many students preferred that instructors use the LMS consistently to deliver content as this can enhance perceived flexibility in learning. These results are in the line with the work of Sanford et al. (2017), Song et al. (2004), and Wu (2016). Song et al. (2004) found that students appreciated the convenience and flexibility associated with being enrolled in online courses, as they did not have to travel to campus to attend face-to-face classes. Wu (2016) showed that the perception of high quality design of course content (including its visual aesthetics and utility) in an online learning experience was associated with increased outcome behaviour (as measured by the content analysis of essay responses). Wu suggests that high quality design of online courses encourages extended engagement with course content and increases enjoyment and motivation. Moreover, good design of the online learning environment can help to meet students' basic psychological needs, thereby enhancing self-regulated motivation (Hsu et al., 2019), perceived and actual learning (Bolliger & Halupa, 2018), and engagement (Cole et al., 2019; Ghapanchi et al., 2020). Further research is needed to determine the degree of influence that the visual appearance of the LMS has on an online course and its effects on engagement, motivation, GPA and satisfaction with GPA, and other learning outcomes (Chen & Jang, 2010). Research into these topics must also consider the impact that the pandemic has had on students' expectations and perceptions about online learning and the visual design of LMS', given that many more students have been exposed to this course delivery mode than ever before.

## Limitations and Future Research

Although our study provides some insights into the importance of the visual design of the LMS to student learning experiences, we acknowledge several limitations. First, our sample of participants was small, limiting the ability to generalize our findings. We suspect that students may have been overwhelmed with their online learning experiences and may have also experienced screen and survey fatigue during the pandemic. As such, we consider this research exploratory and suggest that further research involving larger populations of students from several postsecondary institutions using a variety of LMS is warranted to confirm and build on our results. Second, we did not examine the validity of the *Use and Perceptions of Learning Management Systems Survey* that we developed in this study due to our small sample. In future research it would be interesting to examine the factor structure of our survey, particularly those sections designed to capture information related to the learning experiences of students, and to gather evidence for convergent and divergent validity with our measure. Third, as mentioned above, we did not ask postsecondary students about accessibility issues that may have impacted the results of this study. This is a critical area of future research considering that the educational outcomes of a considerable proportion of students with visual impairments in Canada are negatively impacted (Statistics Canada, 2009). Finally, students in the current study were not asked about the degree to which their instructors and other students interacted with them through the LMS. A community of learning is viewed as very important to students enrolled in online courses, and the lack of interpersonal interactions can lead to less satisfaction with online learning (Song et al., 2004).

## Conclusion

We examined students' perceptions of the visual design of the LMS and learning experiences using survey methodology. We explored the relationships between educational experience, familiarity and satisfaction with an LMS, visual design and colour, and satisfaction with the learning experience. Our results suggested that exploring the impact of colour and various other visual design aspects of LMSs on student engagement and learning are important and have practical value for LMS developers, instructional designers, and instructors. With additional investigations involving a larger participant sample, we can examine the factor structure of our survey, consider students' accessibility issues (e.g., visual impairment) when designing studies. The findings contribute to knowledge of the design of online teaching and learning environments considering students' overall learning experiences in Canadian postsecondary institutions.

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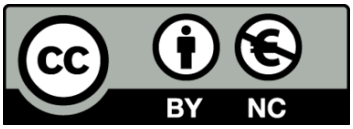

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# Rhizo-Creation of Second-Language Teachers' Capacity for Technological Integration

# Rhizo-Création de la capacité d'intégration technologique des enseignant.e.s de langue seconde

***Francis Bangou,*** *University of Ottawa, Canada*

**Abstract**

This article puts to use the work of Deleuze and Guattari to build new knowledge and understanding associated with the circumstantial nature of becoming a technology-capable language teacher through experimentations with/in the agencements of an ongoing research project associated with the design and delivery of a 12-week online graduate course in computer-assisted language learning (CALL). Methodologically, data collection encompassed participants' assignments, semi-structured interviews, course materials, and researcher's journal. Moreover, rhizoanalysis was deployed to map change and potentialities in teachers' becoming. Scholarly contributions to the fields of technology, learning, and teacher education relate to re-theorizing the role and effect of human, expressive, and material elements in teacher education in CALL, as well as developing new methodologies to research micro-level singularities and emergent potentialities for teaching and learning with/in teacher education.

*Keywords*: Language education; Technology; Teacher education; Deleuze; Rhizoanalysis

**Résumé**

Cet article met à profit le travail de Deleuze et Guattari pour produire de nouvelles connaissances et compréhensions sur la nature circonstancielle du devenir enseignant.e de langue capable d'utiliser les technologies en expérimentant avec / dans les agencements d'un projet de recherche en cours associé à la conception et à la prestation d'un cours de deuxième et troisième cycle en ligne de 12 semaines sur l'Apprentissage des langues assisté par ordinateur (ALAO). Sur le plan méthodologique, la collecte de données comprenait les devoirs des participant.e.s, des entrevues semi-structurées, le matériel de cours et le journal du chercheur. De plus, la rhizoanalyse a été déployée pour cartographier les changements et les potentialités du devenir enseignant.e.s. Les contributions savantes aux domaines de la technologie, de l'apprentissage et de la formation du personnel enseignant se rapportent à la ré-théorisation du rôle et de l'effet des éléments humains, expressifs et matériels dans la

formation du personnel enseignant à l'ALAO, ainsi qu'au développement de nouvelles méthodologies pour rechercher les singularités de micro-niveau et les potentialités émergentes pour l'enseignement et l'apprentissage avec / dans la formation du personnel enseignant.

*Mots-clés* : L'Enseignement des langues ; La technologie ; Formation des enseignant.e.s ; Deleuze ; Rhizoanalyse

## Entry Point

Throughout the years, numerous epistemologies and methodologies have been used to try to capture the process and outcomes of teacher education in computer-assisted language learning (TEDCALL) (Hubbard, 2019; Kessler & Hubbard, 2017; Sun & Zou, 2022). What emerges in part from these inquiries is that teacher development in computer-assisted language learning (CALL) is a complex and situated process (Arnold & Ducate, 2015; Son & Windeatt, 2017). As such, Arnold and Ducate (2015) have argued for more research to "help us identify ways in which CALL teacher education can successfully account for the context-specific nature of teaching and learning" (p. 6).

This article draws on the work of Deleuze and Guattari (1987) to think about and do TEDCALL differently through experimentations with/in rhizomatic transformative interconnections amid human, material, and expressive elements associated with the process of becoming a technologically capable second language (L2) teacher. Methodologically, rhizoanalysis (Masny, 2016) was deployed to map change and potentialities in pre-service teachers becoming with/in the *agencements*[1] ("assemblage," in English; Deleuze & Guattari, 1987) of an ongoing research project associated with the design and delivery of a 12-week TEDCALL online graduate course.

This article also relates to recommendations by Hubbard (2019) and Zhang (2022) to prepare pre- and in-service L2 teachers to engage with change, as technological innovations are constantly reconfiguring L2 teaching and learning practices. This article puts forth the idea that Deleuze and Guattari's relational ontology of becoming can help achieve this goal, as it provides conceptual and methodological resources to think and work with/in intricate and ever-changing circumstances (Bangou & Vasilopoulos, 2018).

## Theoretical Framework

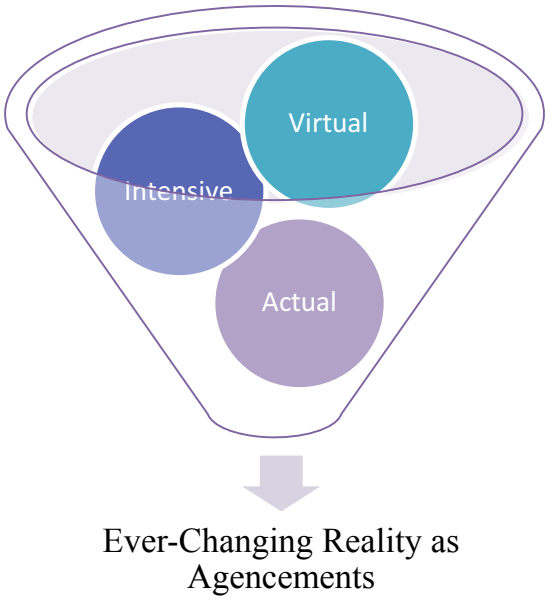
In Deleuze and Guattari's (1987) view, reality is an emergent production of constant interplays between three realms: the virtual, the intensive, and the actual (Figure 1). The virtual realm is situated beyond human consciousness and is the plane where structures and categorizations are flattened, and where *potentials to become* exist—potentials that constantly fold, unfold, and refold into perceptible

[1]In this paper, the original term "agencement" will be used, because the word "assemblage" does not fully communicate the unpredictability and consistent reinvention that is central to the concept of "agencement." See Bangou (2014) and Buchanan (2017).

expressions in the actual realm (i.e., in the tangible reality). The intensive realm, located between the actual and the virtual, encompasses the productive capacities, resonances, forces, flows, and connections that continuously and differently contribute to the actualizations of potentials to become (Bangou, 2020). Both the virtual and intensive realms are immanent to the actual and, as such, are as real as what is perceived—and what is perceived as being real, in short, are the expressions of potentials to become.

**Figure 1**

*Unfolding of Reality*




Thus, *becoming* refers to ongoing, singular, and unpredictable transformations of potentials that cannot be reproduced. As such,

> To become is never to imitate, not to "do like," nor to conform to a model . . .. There is no terminus from which you set out, none which you arrive at or which you ought to arrive at . . . [f]or as someone becomes, what he is becoming changes as much as he does himself. (Deleuze & Parnet, 1987, p. 20)

Becoming occurs with/in agencements, which refer to the way heterogeneous elements connect immanently to co-produce something new (Bangou & Vasilopoulos, 2018). In terms of composition, agencements consist of expressions (i.e., regimes of signs) and content (i.e., entities), as well as intermingling forces of territorialization (i.e., stabilization), deterritorialization (i.e., destabilization), and reterritorialization (i.e., restabilization) (Deleuze & Guattari, 1987). Desire, then, is an intensive force that can potentially destabilize agencements and contribute to the co-production of something new. For instance, a teacher's desire to use a new technological resource is always connected with other elements, such as their career. With/in these desiring agencements, the new technology may become a resource to impress a colleague or to secure a promotion that might be under threat (i.e., the

content). These connections between technology-career-promotion-threat in the intensive may actualize as the adoption or rejection of the technology (i.e., sign), depending on the intensity (i.e., strength of effect) of each connection (i.e., force).

Agencements are therefore bounded by ever-changing mutable connections occurring in the intensive and, as such, are themselves in constant variation (Bangou, 2014). What matters, then, is to experiment with the transformative capacities of elements with/in agencements, and with what these capacities might become, and with how they are validated (Buchanan, 2017).

According to Deleuze and Guattari (1987), relationality with/in agencements is foremost rhizomatic (i.e., disruptive, alogical, non-linear, and multiple, and with no order, no hierarchy, no beginning, and no end)—including relationality between content and expression in that there is neither correspondence nor conformity between the two elements. In other words, the relationship between one's refusal to use a technological tool and one's willingness to use technology cannot be reduced to a straightforward and logical signifying correspondence (i.e., meaning), but rather to the ways in which sense emerges out of non-sense and functions with/in rhizomatic relations of "resonation, interference, amplification, and dampening" (Massumi, 1996, p. 219) associated with the desiring agencements produced when teachers and technology collide. Sense, then, lies at the intersection of content and expression, emerging when entities and regimes of signs come together rhizomatically and intensively (Deleuze, 1990). Therefore, a relational ontology of becoming is more preoccupied by experimentations the transformative and destabilizing capacities of nonsense than by the discovery of meaning.

Learning, then, occurs with/in the process of becoming, and encounters with non-sensical expressions of reality. In that regard, non-sense becomes a thought-producing problem that could lead learners and learning down unexpected and transformative paths dependent on the forces at play at specific times and in specific spaces. For instance, some readers may have trouble making sense of this article, as they may not be familiar with Deleuzo-Guattarian inquiries. As a result, this agencement of readers—article—learning may result rhizomatically in the emergence of thoughts and connections with other elements (e.g., intense feelings of uneasiness, etc.). These unpredictable (and potentially disruptive) emerging connections might then lead the agencement of readers—article—learning down a transformative path. For instance, the desire to find out more about Deleuzo-Guattarian research or anything else could emerge. That is why what could constitute evidence of learning remains uncertain, as "we never know in advance how someone will learn: by means of what loves someone becomes good at Latin, what encounters make them a philosopher, or in what dictionaries they learn to think" (Deleuze, 1994, p. 165). Hence,

> we learn nothing from those who say: "Do as I do." Our only teachers are those who tell us to "do with me", and are able to emit signs to be developed in heterogeneity rather than propose gestures for us to reproduce. (Deleuze, 1994, p. 23)

Consequently, the role of teachers is not to scaffold learning to ensure that learners reproduce a pre-established notion of a desired outcome, but rather to provide a space for learners to discover

thought-producing problems (Bogue, 2013) and experiment the transformative capacities of their learning agencements (Bangou, 2020).

Learning how to integrate digital technologies into a language classroom, then, is not equal to an act of mimicking (e.g., being or acting like) a performance indicator; rather, it is a rhizo-creation of nothing else other than itself, as affected by intensive connections between tangible and intangible human, material, and expressive elements.

## Teacher Becoming in CALL

In light of the above framework, teacher becoming in CALL (TBIC) (Bangou & Vasilopoulos, 2018) has been put forward to think and do TEDCALL differently. TBIC focuses on the act of transforming tangible and intangible elements of the world with/in the agencements associated with research and TEDCALL. As elements of the agencements themselves, teachers, teacher educators, students, and researchers all contribute to the emergence of TBIC—and can all potentially be transformed by any other elements, be they human, material, or expressive. As such, only through experimentation can teachers, teacher educators, researchers, and students get a sense of all the possibilities that CALL offers with/in their agencements (Bangou &Vasilopoulos, 2018).

Teacher becoming in CALL is well equipped to engage with transformation and change (as opposed to reproduction and stability) in teaching and learning, as change and difference (not repetition and sameness) become the points of reference. TBIC also provides a space to account for the context-specific nature of teaching and learning. Indeed, TBIC disrupts the logic that if "the language, structures, organisation and administration of teacher education are established, then the right kind of pedagogical practices and desired forms of learning will somehow emanate from that" (Gale, 2007, p. 472).

## Research Questions

Drawing from the above theoretical framework, the following research questions will guide this article to experiment with TBIC's capacity to transform and be transformed with/in teacher trainees' becoming in CALL: With/in the agencements of the teacher trainees' reflective multimedia collages and this article, (a) how do the concept of TBIC and learning to engage with change connect with other tangible, intangible, human, material, and expressive elements? (b) how do these connections transform the capacity to change and be changed of TBIC, learning to engage with change, and other tangible, intangible, human, material, and expressive elements? and (c) how are these transformations validated?

## The Learning Space

The learning space for this study emerged as a 12-week online graduate-level TEDCALL course. During this course, the teacher trainees (herein, the "students") had the opportunity to

experiment with what they might become with/in CALL while navigating through five modules that focused on diverse topics associated with digital technologies integration in the language classroom (for more information, see Bangou & Vasilopoulos, 2018).

To experiment with/in their becoming in CALL, students could choose between two paths in the course curriculum. Both paths merged the principles of project-based, situated, and reflective learning—an approach that aligns with Guichon and Hauck's (2011) recommendations to combine reflective and exploratory practices to help teachers gain understanding of the complexities associated with integrating digital technologies in the L2 classroom. One path was a community service learning (CSL) option. Students who selected this option volunteered with an educational institution or a community-based organization for a minimum of 30 hours and worked on a project pertaining to the integration of digital technologies in language education under the guidance of a community supervisor. To guide students' experimentations, they were also required to maintain a blog and post weekly logs triggered by prompts provided by the instructor, inspired by TBIC, and readings from the course, such as "What connections can be made to technologies and languages?" The other path was the regular course option.[2] Students who chose this option spent the session working, in teams of two or three, on a technology-integration project based on an authentic or a fictional situation; they were also required to contribute, in their groups, to three discussions on an online forum, with each post offering reflective analysis about session readings and various TBIC-inspired prompts provided by the instructor (e.g., "Did something in the readings unsettle**,** disturb, or otherwise "get to" you? If so, what did that produce?") (Bangou & Vasilopoulos, 2018).

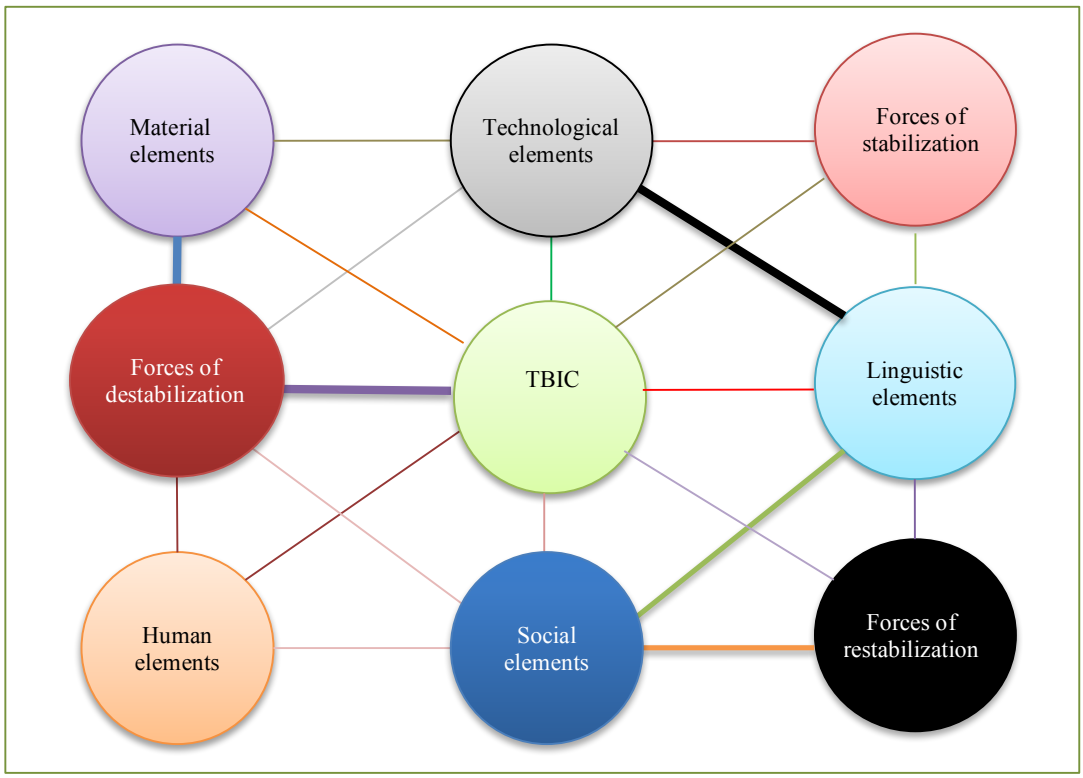
More relevant to this article was the final assignment, in which all students had to work individually to design a reflective multimedia collage of their becoming in CALL. This assignment required them to engage with change by mapping the elements that contributed to their transformations throughout the session and by considering the potentiality of their becoming in CALL. A visual expression of TBIC (Figure 2) was available on the online platform to help students think *in* the singularity and creative potential of their becoming in CALL (Bangou, 2020). Students also had access to an audio recording that explained the visual expression of TBIC in more detail. Students were then asked to share their collages on an associated website that acts as an interactive platform to create new potentials for TEDCALL (Appendix A).

Figure 2 itself is an agencement with multiple points of entry (e.g., social elements, forces of destabilization, etc.) but with no beginning and no end. It is composed of intermingling material, technological, linguistic, social, and human elements along with forces of stabilization, destabilization, and restabilization. While elements of this agencement are situated at random, TBIC is centrally located to express that it is the concept that guides one's thinking with/in pre- and in-service teachers' becoming in CALL. Moreover, the various arbitrary colours and thicknesses of the connecting lines express that elements of the agencement never connect the same way twice (colour) and with the same intensity (thickness) (Bangou, 2020).

[2] The Centre that coordinates the CSL program recommends this assignment be an optional component of a course. As such, students must also be provided with another optional path to meet the course requirements.

**Figure 2**

*A Visual Expression of Teachers Becoming in CALL*




To date, the course has been delivered multiple times; the present study's field material and findings stem from the second time this course was delivered.

## The Study

### Research Design and Method

Deleuzo-Guattarian-inspired research recognizes that scientific knowledge is produced with/in flows of transformative connections generated in part by the methodology and methods engaged (Fox & Alldred, 2015). To produce knowledge differently, "it is no longer what happened that matters so much, but rather what is happening now and what can happen next" (Vannini, 2015, p. 11). In this approach, researchers are no longer preoccupied by representation, description, and reporting. Rather, "it is enactment, rupture, and actualization that engage" their attention (Vannini, 2015, p. 11) to map the ways elements of an agencement resonate, amplify, disrupt, and diminish, and consider what these transformations may produce. To do this, research moves towards a decentring of the researcher as a subject. Instead, the researcher engages in flows of rhizomatic and intensive connections that occur from different parts of the research agencement in action, so that unexpected elements might emerge to become transformative forces in the analysis of the collected field materials (Coleman & Ringrose, 2013).

### Participants Recruitment

Twenty-one students attended this online graduate-level course the second time it was offered. At the session's end, after grade submissions, all 21 students were invited to participate in the research project, of which 8 students agreed to participate in this study.

### Collection of the Field Material

To provide a sense of their experiences with the online course, course material, participants' blog logs, and postings to the online forums, reflective multimedia collages and projects were gathered. Seven of the eight participants also agreed to take part in a semi-structured interview via Skype. The approximately 25-minute-long interviews took place at the end of the session, after the final grades were submitted. They were recorded and subsequently transcribed. The Deleuzo-Guattarian-inspired interview questions were designed to enable participants to share their experiences the teaching material, the technological tools used in the course, and the course assignments. The interviews also enabled students to talk about the ways their experiences in this course transformed their thinking about technology in language education (Appendix B). Moreover, as a researcher, I kept a journal on my experience while designing and teaching the course.

### Analysis of the Field Material

Rhizoanalysis (Masny, 2016) guided the analysis of the collected field material for this article. This analytical orientation to research does not seek to uncover the meaning of a phenomenon, but rather to think *in* the field material to map the connections occurring in the intangible. Accordingly, field materials are chosen not based on their representative capacity (i.e., actualizations), but according to their capacity "to act and intervene rather than be interpreted" (Colebrook, 2002, p. xiv). With the objective being experimentation, the researcher serves "as a mediator who works within the map so that it can continue to compose, associate and transform" (Nordstrom, 2015, p. 179). Hence, rhizoanalysis is a process of mapping that emerges from the researcher's own becoming. By emphasizing the unique moments in which intensive connections are made, the focus is no longer placed on identifying patterns across data, participants, and context, but rather on considering the transformative and creative capacity of singular and intensive moments and experiences. Nonetheless, when thinking *in* the field material, some patterns could emerge that might be considered for their transformative capacity. Hence, rhizoanalysis primarily involves asking questions to reconsider what else might be occurring and what else might be produced (Masny, 2016).

## Becoming Vignettes

When conducting a rhizoanalysis, instead of talking about data, we talk about "vignettes" which are sense making moments in a research agencement. Vignettes become analytical points of entry based on their capacity to transform a research agencement and to be transformed by this agencement (Masny, 2016). The following vignettes focus on the experiences of three participants: Morgan, John, and Carrie (all pseudonyms). Vignettes were selected from the participants' reflective collages based

on those vignettes' capacity to resonate with the researcher and thereby to stand out as "interesting, remarkable, or important" (Deleuze & Guattari, 1991/1994, p. 82) regarding the participants' becomings. The following vignettes' transformative passages are bolded to show when connections happened in my mind while intense streams of thought were being produced (Masny, 2016). As a rhizoanalysis focuses on the transformative capacities of singular moments rather than interpretations, readers are invited to consider the possibilities offered by the following data vignettes and think about what they might be capable of producing with/in the agencements of their own becomings.

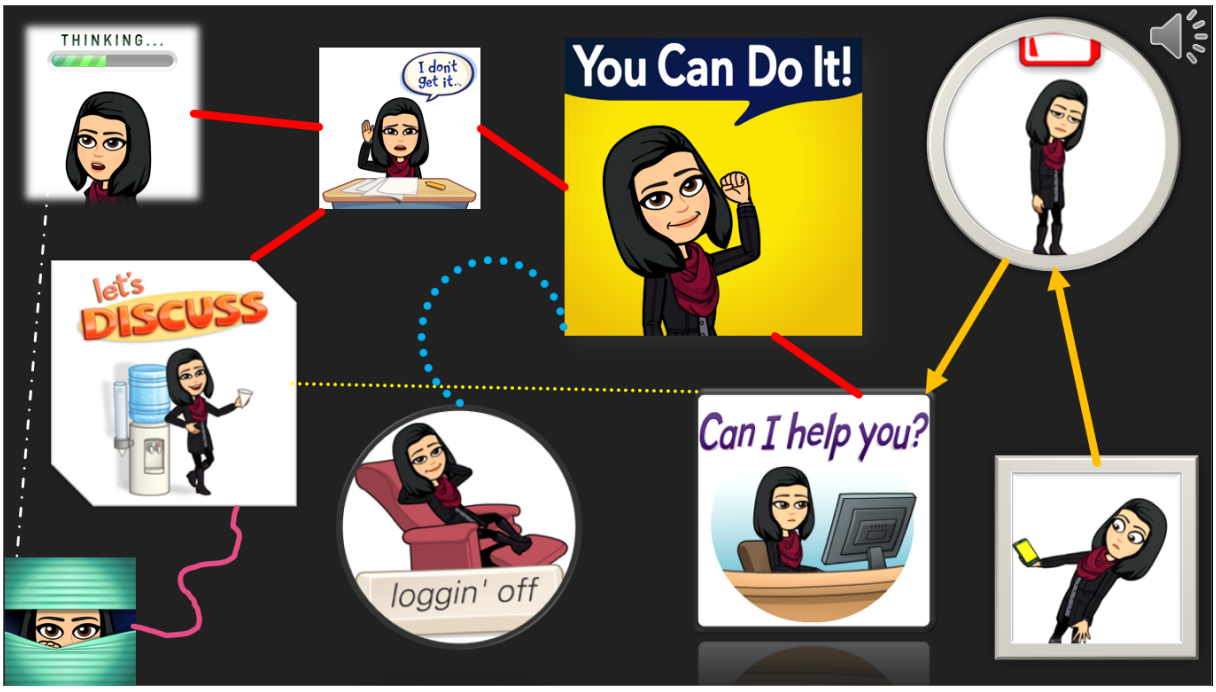
## Findings

### Vignette 1: "Not the end of my TBIC journey"

The following vignette is associated with Morgan's multimedia collage, which caught my attention because it was very close to the visual expression of TBIC that was uploaded to the course platform. Morgan's collage actualized as a PowerPoint presentation, and the quasi-totality of the slides followed the same format as in Figure 3. With each slide, one could hear an audio recording that addressed an element of the participant's becoming in CALL.

**Figure 3**

*Morgan's Multimedia Collage*




As explained in her introductory slide, the various images were "placed randomly on the page with random connections, different shapes and various sizes of images that represent the different elements" that she experienced both during the course and through her own teacher becoming in

CALL. Elements that she discussed included material, human, social, linguistic, and technological elements as well as forces of destabilization and stabilization, as specified in the assignment instructions.

At the time of the research, Morgan was an English as a Second Language (ESL) teacher at a university. Prior to this position, she had spent four years teaching English Arts and ESL in South Korea, during which time she used technology daily to present content to students, manage the class, and conduct learning activities. She did not use technology as often in her Canadian classroom, mostly because the curriculum at her Canadian institution was more textbook-based. With/in the course, she selected the path of the regular course option. This is what Morgan said on the collage's last slide:

> Overall, this collage expresses that my journey, my becoming in CALL **is made up of many elements and these elements will continue to be different over time as I move forward backward and around in my own becoming in CALL**. My own experience **is now something that I see** as dynamic, and moving, and growing, and as such I feel that **this collage highlights some of my own experiences that are probably quite unique and perhaps different from other educators who are learning to integrate technology**.

Thinking *in* the agencement of this expression of Morgan's becoming in CALL, it appears that when Morgan and the concept of TBIC collided, new understanding was produced regarding learning how to integrate technology. Moreover, it seems that pre-established desired outcomes materialized as Morgan expressed how her viewpoint changed and how her experience was henceforth perceived as dynamic and singular. As such, Morgan's becoming in CALL, as expressed in her collage, could be considered successful learning. However, TBIC reminds me that there is always more to reality than one perceives, which begs the question: What else might be occurring with/in this expression of Morgan's becoming in CALL? For instance, how might technology have amplified (or not) both (a) the capacity to transform and be transformed by TBIC, and (b) the capacity to learn to engage with change?

Throughout the course, students were encouraged to experiment with the expressive capacity of technology to explore other modes of expression besides text. I hoped that these expressive technological experimentations could serve as catalysts for more transformative experimentations with other ways of learning besides reproducing predetermined outcomes. I now realize that with/in Morgan's collage, TBIC was barely transformed, as the elements I used as examples to explain TBIC (Figure 3) were the same ones used with/in Morgan's collage to guide her own reflection. For instance, the example of interactions was provided by me to illustrate what could be a linguistic element at play with/in one's own TBIC, and Morgan also referred to interactions in her slide associated with linguistic elements. Still, thinking *in* the agencement of technology—TBIC—learning to engage with change, I now wonder about elements not actualized in the above vignette that might have amplified (or not) the capacity of technology to transform and be transformed.

One particular memory emerges in my mind: in her interview, Morgan expressed that she had struggled a bit with the concept of TBIC when she first came in contact with it, so to make sense of TBIC she tried to keep "a little journal or memo of things that were happening throughout the course"

or ideas she had. Thinking *in* the agencement of TBIC— struggle—sense—technology— learning to engage with change, I come to wonder if both technology's and TBIC's capacity to transform was dampened by struggle and sense in this case. Anything could have happened when these elements collided, but it appears that what was produced was the desire to use a journal. Now, I remember that the use of a journal was also recommended in the instructions provided to students. I also remember that desire is always associated with combinations of things. So, what other elements were at play with/in the desiring agencement of journal—sense—struggle—TBIC—technology—learning to engage with change? I now recall that in her interview, Morgan also expressed that having the option "to be creative was actually kind of nice and unique compared to some of the other stuff" she was doing online. Although Morgan enjoyed the creative freedom provided by the assignment, she only went a short way down that route, as she carefully ensured she followed the instructions to reproduce TBIC.

She also explained in her interview the reason why she enjoyed having this creative freedom:

> As adult learners, sometimes our mindset is so focused on, like, am I going to do well? What about my mark? **I don't want to do something and then it throws off or has this effect and I don't do well in this course because I misinterpreted what was being asked of me**.

Was the fear of misinterpreting the instructions and getting a bad grade at play with/in the desiring agencement of journal—making sense—struggle—TBIC—technology—learning to engage with change—creativity? Did the workings of these elements reduce Morgan's capacity to experiment with change and with what she might become? Was the fear of getting a bad grade a powerful validating force of reproduction with/in Morgan's becoming in CALL?

In any case, it appears that providing students with the space to be creative might have slightly destabilized the reproductive power of her fear of getting a bad grade. Now I wonder: was Morgan's statement on the last slide of her collage (Figure 3) *really* an expression of change with/in her capacity to develop new understandings about learning how to integrate technology, or her capacity to experiment with other ways of knowing, or her capacity to engage with change? Or was it simply an expression of her capacity to ensure she gets a good grade? Could I still consider Morgan's learning a success? Here, I am reminded of the rhizomatic and intensive relationships at play between form and content, and I step away from binary thinking to embrace instead the multiplicity of potentials to become. As such, Morgan's statement was an expression of neither failed nor successful learning; rather, it was simply what Morgan's potential to transform became in the last slide of her PowerPoint—and of what this potential might become from that point forward.

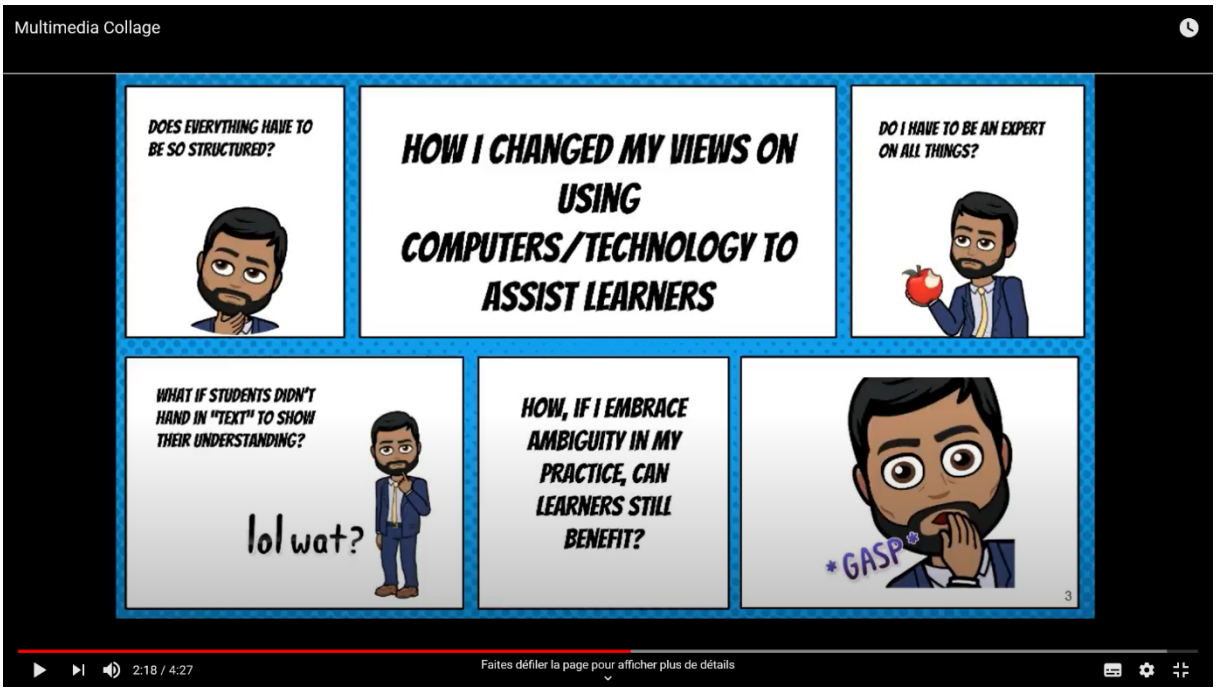
**Vignette 2: "Does everything have to be structured?"**

Just like Morgan, John picked the regular course option and appreciated the creative freedom provided with/in the design of the multimedia collage. However, unlike Morgan, John's collage materialized as a YouTube video, wherein TBIC transformed into the video *My Journey in CALL*. This video caught my attention because, apart from the introductory title, there was no other explicit reference to TBIC in John's video, as illustrated in Figure 3. Instead of carefully following my

instructions, John tried “to take the ideas” that he had “learned in the course and apply them to this multimedia collage.”

**Figure 4**

*A Screenshot of John’s Video*




Prior to this course, John had worked as an English teacher in a secondary school classroom for 14 years. Following that, he became a resource teacher for instructional technology. At the time of this research, John was helping teachers of diverse disciplines within his school board to integrate technology into their classrooms. This is what John said in his video about what he learned in the course:

> I feel like I know a lot about technology and how it can be integrated to help students learn. But I have also learned **a little bit throughout the course about what we can do, so that it’s not so text-heavy in terms of showing their understanding; and you will see in this collage, it is not a lot of text—it’s more showing emotions through emojis**. **So, in terms of changing my views on using computers or technologies to assist learners, I thought about . . . I was challenged throughout the course to think about . . . does everything have to be structured**? **Does it have to be a structured piece of writing, for example, with a thesis and supporting details? I also thought about doing: Do I have to be an expert on all things? Because there is so much technology that is out there that we can’t possibly know everything**. **Sometimes that makes teachers feel uncomfortable because it means that they may have to embrace ambiguity.**

This vignette brings forward thoughts of interwoven linguistic, technological, human, and social elements with/in John's becoming. Indeed, in this agencement, many elements seem to be interconnected, such as text—emojis—feeling uncomfortable—showing understanding—learning—structure—and . . .

I come then to wonder about the transformative capacity of emojis (as characteristics of technology) with/in the agencement of John's collage. More specifically, I wonder about the ways in which the elements of the above agencement may have amplified (or not) the emojis' capacity to transform and be transformed by learning to engage with change and language. Certainly, being able to experiment with other means of expression besides text seems to be a course element that resonated with John in particular ways, as it triggered thoughts associated with not only changing a practice, but also the power of structure, texts, and ambiguity with/in his profession. Could this also be a manifestation of a transformation of John's capacity to engage with change? Anything could have happened at this point, but it seems that the interworking of these elements contributed to the emergence of a desire to experiment with the expressive capacity of technology with/in his collage using emojis. Could emojis, then, be elements with/in John's becoming that amplified the capacity of technology to make John transform his thinking regarding the clarity of text with/in his own learning? Were text and clarity validating reproductive forces with/in John's becoming in CALL? Thinking back to the validating reproductive power of grading with/in Morgan's becoming, I wonder if this element was also at play in the virtual when John was thinking *in* the design of his collage.

At this point, a memory of John's interview emerges regarding something he said about his collage:

> This allowed more freedom and more creativity, so I think that I appreciated it on a different level perhaps because **I know that I was one of the older students in the class, and I've been sort of removed from being a student in the . . . in, um, postsecondary for a little while, so I don't still have that same, you know, groove of, you know**, "We've got to do it this way. What do I have to do to just get a certain mark?" **. . . I'm more in it for my own learning . . . rather than just wanting to make sure that I get a degree. That's the big problem with a lot of our students—that drive for getting good grades rather than a drive for learning.**

It appears that the element of grades was also at play with/in John's becoming, but the drive for learning seems to have interfered with the validating reproductive power of getting good grades when both elements collided with John's age. We will never know what would have happened to John's becoming if these elements had not connected, but it appears that what was produced was an appreciation of creativity on a different level.

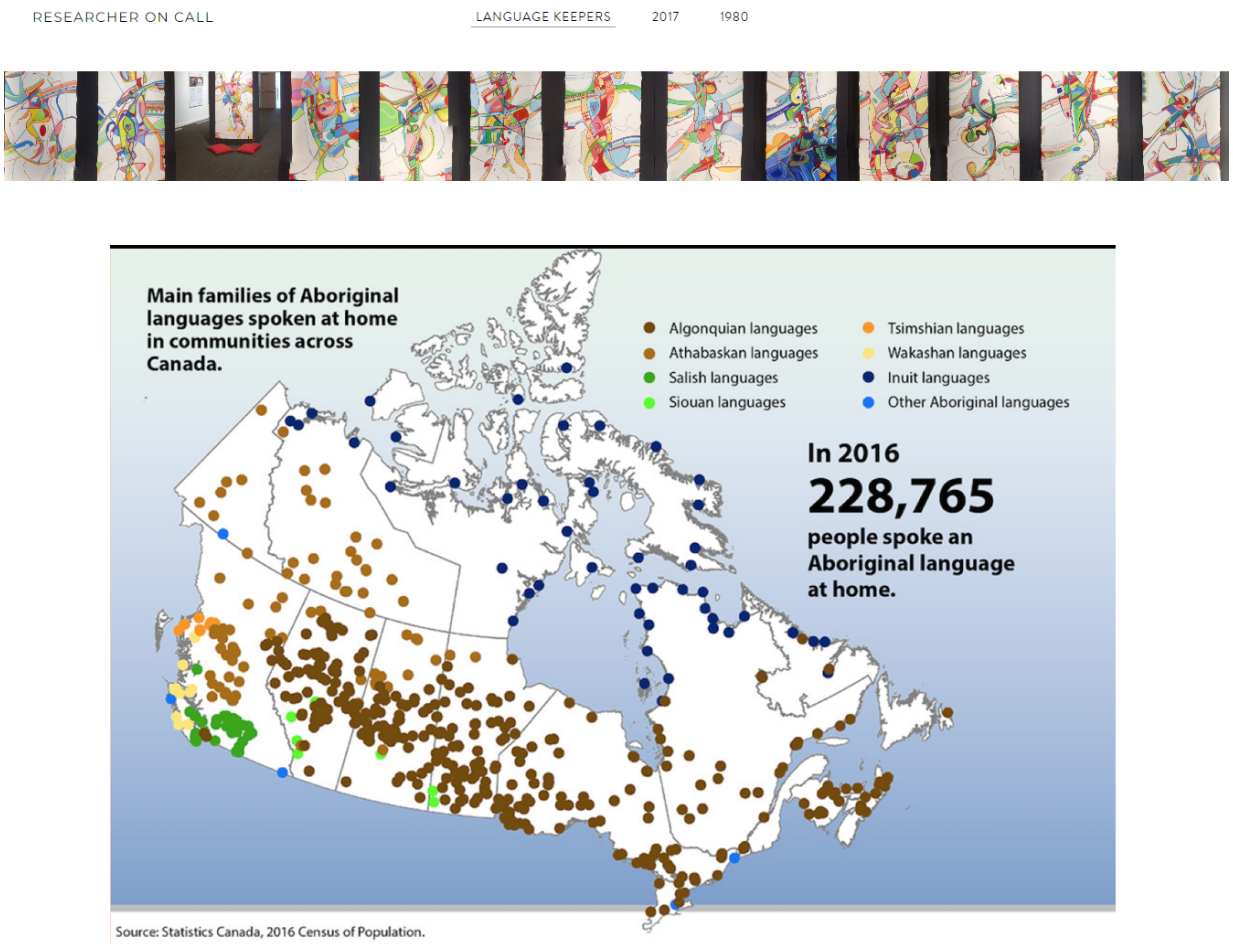
At this point, thoughts arise about another student—Carrie—who, like John, had been away from being a student for a long time, but who brought creativity to another level.

### Vignette 3: Researchers on CALL

The third vignette is associated with Carrie's multimedia collage, which caught my attention because, in my view, it was the one that expressed the most creativity that year. Carrie's multimedia collage materialized as a website.

### Figure 5

*A Screenshot of Carrie's Website*




As she explained in the introductory text posted on the course website, she wanted to highlight three things that resonated with her "most deeply in this course." She "intentionally sought, on three webpages, to give each topic very different treatment," to push herself "creatively and take some technological risks." Notably, Carrie was not a language teacher or a language teacher educator. In traditional research on CALL, data that is not associated with language teachers specifically may be considered irrelevant and may therefore be dismissed. However, TBIC reminds me that there is also transformative potential in difference. Hence, the following rhizoanalysis may open unexpected lines of thought and take the online course and TEDCALL down transformative paths not conceivable otherwise.

Carrie had been a journalist for most of her life and had also worked in developmental organizations. At the time of the study, she had been employed at the university full time for two years as a senior writer and editor. Her education up until then "was pretty language-y," and she had become especially interested in the combination of language and technology. She chose the CSL option and was placed with the Institute of Canadian and Aboriginal Studies. Her assignment there was to produce a report on the ways in which technology could help revitalize aboriginal languages. This is what Carrie said in the introductory text of her collage shared with the other students on the associated website:

> **Researcher on CALL:** I'm not a teacher, but after this course, **I do feel that I would like to continue researching in this field. In coming up with a subtitle for my website**, I further tweaked **"teacher becoming in CALL" by changing "*in* CALL" to "*on* CALL"** (by playful analogy with "Doctor on call," though probably no lives will be saved as a result of my research). The overarching **concept behind the website is that I wanted to *show* rather than *tell***—to demonstrate some of what I've learned by presenting what **the website of a "researcher on CALL"** might look like as they showcase their various research interests.

Interestingly, with/in Carrie's collage, TBIC did transform into "researchers *on* CALL." I slow down and think *in* the elements that contributed to the transformation of "Carrie, the Editor" into "Carrie, a researcher *on* CALL." For instance, I consider the ways that the agencement of TBIC—the CSL project—desire to show rather than tell—Indigenous languages—learning to engage with change contributed to such a transformation. At this point, thoughts emerge in my mind regarding something Carrie said about another section of her collage:

> **I also wanted to convey something of what I've learned about Indigenous languages, that they are place-based, polysynthetic—and poetic.** Looking **through CreeDictionary.com**, for example, I was struck by how many entries relate to the natural world and life outdoors, with words so packed with meaning that the English translations may use as many words as the Cree word has letters (in Roman orthography). **For example, *nâtâhowew*: "she goes toward people, swimming or paddling a canoe." I felt an immediate affinity for that word** and felt it summed up my CSL experience nicely.

Evidently, Carrie's "immediate affinity" with the Cree word *nâtâhowew* arose when she unexpectedly encountered thoughts of her CSL experience. Might this unexpected, intensive encounter have amplified the capacity of Indigenous languages to transform Carrie into a researcher *on* CALL?

To speed up Carrie's becoming in CALL, I consider what her learning to engage with change *could* have looked like if she had been a teacher or had encountered other material and expressive elements besides the word *nâtâhowew*. I then think of her video collage which is situated on the 1980 page of her website. In her interview, Carrie explained that in that "retro" video, she wanted to:

> try to include some *very latest* technology, **to play with the idea that modern tools can help us connect with our past**. For this, I dipped into Google's 3D Poly[3], launched in November . . . But this is where **I found** the manual typewriter gif **that I use at the start of the video.** I had never worked with a gif before, **but knew that I had to try when I saw the Poly object that looks much like the portable Olivetti I had used to produce the long-ago master's thesis**.

In this video, many elements seem to be related: video—writing—her master's thesis—fun—past—modern tools. It appears that Carrie wanted to "play" with the connections between past and present in this video, using modern technology to "talk" about an experience with past technology. I am then led to wonder: could this be the manifestation of Carrie's potential to become regarding her capacity to engage with change? I then wonder about how other elements of this agencement could amplify this potential. For instance, I think *in* the ways that the thought of Carrie's old Olivetti portable typewriter emerged when she encountered the typewriter gif image, and the way these thoughts may have amplified the capacity of this image to transform Carrie's capacity to engage with change (and not just with reproduction). No one could have predicted this encounter, and we will never know what would have happened if this encounter had not occurred. Regardless, it looks like it did contribute to the emergence of her desire to work with such a gif and to experiment with change (i.e., changes in time) and with a new set of technological tools.

## Aperture

In response to research question 1, it appears that the agencements of students' reflective multimedia collages and this article, learning to engage with change and the concept of TBIC connected rhizomatically with multiple elements while participants were making sense of TBIC and the collage, and when I made sense of their experiences with/in the writing of this article agencement. Moreover, some elements, such as grades and assignment instructions, were active with/in different agencements—but never with the same capacity to change and be changed. For instance, the capacity of grades to change and be changed connected and materialized differently with/in Morgan's and John's agencements, in part due to the intensity of the connections at play with/in their respective agencements. Indeed, it seems that with/in John's agencement, the capacity of getting good grades to transform learning to engage with change was dampened by John's age and by his intense connections with emojis.

Thus, in response to question 2, it seems that the capacity of TBIC and learning to engage with change to transform and be transformed fluctuated with/in rhizomatic connections of resonance, amplification, dampening, and interference with diverse tangible (e.g., Indigenous languages), intangible (e.g., memories), material (e.g., typewriter), human (e.g., emotion), expressive (e.g., emojis), destabilizing (e.g., ambiguity), and stabilizing (e.g., structure) elements. Many elements became "other" with/in these sense-making rhizo-creative experimentations. For instance, TBIC became a

[3] 3D Poly was shut down in 2021. However, similar applications are currently available online.

journey and a researcher *on* CALL with/in John's and Carrie's collages, respectively. Learning to engage with change became a desire to follow instructions with/in Morgan's becoming; for John, it was a desire to experiment with ambiguity, structure, and language; and for Carrie, it was a video montage with/in a website.

In response to question 3, it seems that validation's transformative capacity also fluctuated with/in flows of rhizomatic connections associated with sense-making. For instance, with/in John's becoming, text became a validating element when it connected with the expressive structures of John's profession; however, its validating power diminished when it connected with the creative freedom at play with/in the expressive structures of the course.

This article put forward TBIC not to control, solve, or represent TEDCALL, but rather to experiment with the capacity of TEDCALL to become something different by creating a space propitious to the emergence of different ways to think and do TEDCALL. This is in line with current research in education and teacher education that explore and problematize the non-linear and complex processes associated with becoming a teacher. For instance, drawing from the concepts of assemblage, rhizome, and becoming, Strom and Martin (2017, 2022) have promoted non-linear ways of understanding the process of becoming a teacher as well as greater awareness of the agentic capacities of non-human elements in teacher education. In the same vein, Ovens et al. (2016) illustrated what can be produced when the Deleuzo-Guattarian concept of becoming is used to think differently the transition for student to teacher. Before them, Gale (2007) argued for "a careful and thorough re-thinking of the theory and practice of teacher education as a terrain of complexity, multiplicity and interconnectedness" (p. 472)—which is precisely what we intended to do with this article.

Hopefully, while making sense of it all, creative lines of thought will emerge that will lead teacher education, technology, language—and the reader—down transformative paths. One of these transformative paths might be associated with the destabilization of the power of reproduction with/in education and the associated research, as well as the way such destabilization might affect teachers' capacity to engage with ever-changing technological circumstances. Another path might be connected to the interworking of form and content in assessment, and to the ways these relationships might be transformed by experimenting with/in the creative and expressive potential of technology, language, and any other regime of signs.

As teacher educators and researchers, perhaps we could spend more time thinking with/in the possibilities offered by practices that take into consideration the transformative power of intensity in one's learning and in research. Regardless of what might become, it is important to remember that the point is not to say that patterns, models, codes, and standards are unimportant in teaching, learning, and research, but rather to say that it is equally essential to consider what these elements might be capable of *doing* and *becoming* when colliding with/in one's learning agencement*,* for we can never know how someone will learn.

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## Appendix A

*Instructions: Reflective Multimedia Collage (as published on the course platform)*

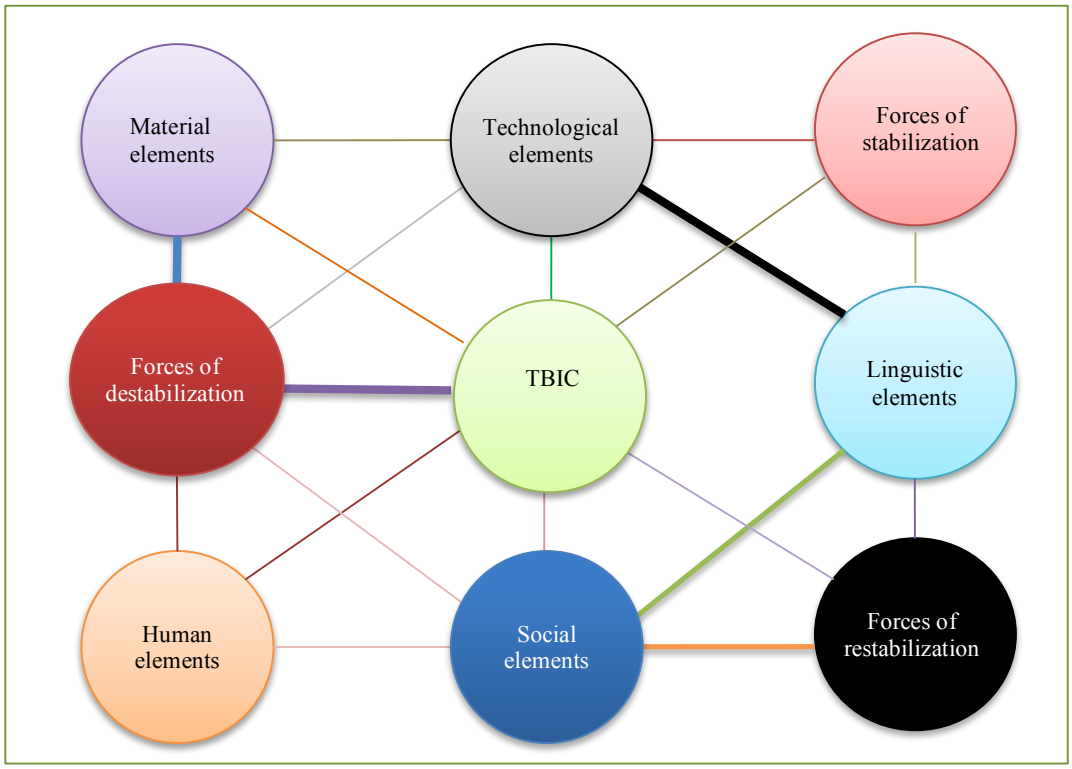
At this stage of the session you are in between two major movements—the official ending of this course and what might happen afterward. Such intermediate spaces are usually propitious to creativity. Therefore, the instructions for this task are purposefully broad to foster your creativity. So, your task in this module is to create individually a multimedia collage of your becoming in CALL throughout this session as a way to disturb current representations of the connections between technology, language, and education. You may also want to use one the following technological resources, or any other resources you may prefer.

- Padlet
- Popplet
- Weebly
- Thinglink
- Piktochart
- Voicethread

Please note: Your collage will be published on the website Disrupting Teacher Education in CALL[4]. If you do not want to be identified on the website, you may want to use an avatar or pseudonym.

**Do not forget:**

"we never know in advance how someone will learn; by means of what loves someone becomes good at Latin, what encounters make them a philosopher, or in what dictionaries they learn to think" (Gilles Deleuze, 1968, p. 165). You may also want to use the visual concept of Teacher Becoming in CALL (TBIC) as explained in module 2 to guide your reflection.




[4] https://www.bang-education.com/

## Appendix B

*Student Interview Guide (at the end of the session)*

1. Can you tell me about your academic background and your experience with technology, language, and teaching?
2. How do you feel about this course?
3. How did you respond to the teaching material in the course?
4. How did you respond to the technological tools in the course?
5. How did you approach the assignments?
6. How did your experience in this course affect the way that you think about technology, language, and education?
7. Is there anything else you would like to tell me about your experience in this course?

## Author

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