

## **Reimagining Multiliteracies for Science and Mathematics Teacher Candidates during the Pandemic**

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## *Reimagining Multiliteracies for Science and Mathematics Teacher Candidates during the Pandemic*

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### *Abstract*

The researchers used a duo-ethnographic approach to examine mathematics and science teacher-candidates (TCs) experiences with a *Multiliteracies Across the Curriculum* course during the pandemic and how the shift to online delivery impacted their attitudes. Through one researcher's course reflections and students' anonymous course survey comments in 2020, the research revealed that some TCs lack of exposure to literacy-based teaching impacted their literacy identities and initial resistance to the course. However, the shift to online learning, increased course relevance, exposure to diverse online methodologies and multiliterate tools seemed to have positively impacted mathematics and science TCs attitudes toward *Multiliteracies Across the Curriculum* compared to previous years.

*Keywords:* Multiliteracy, teacher-candidates, math, science, pandemic, online

### *Introduction*

The demands of the 21st century require complex and multiple literacies. The proliferation of technology and the capacity to easily record, store and send moving images, sounds, and text will continue to change the ways in which we communicate and challenge how we create meaning of and through different forms of communication (Cope & Kalantzis, 2015). Globalization in its broadest sense, not just economic but also social, political, cultural and geographical, and our increased capacity to transcend borders in a wired-up world with increasing people flows, have also created a need for more complex readings and processing of information (Anstey & Bull, 2018; New London Group, 1996). Complex reading practices, in turn, require both a broad knowledge base and a strong capacity for critique and analysis, with consideration of the factors that may affect the form, content, and meaning of messages and information. For educators, this is a catalyst for a multiliterate approach to teaching and learning. A multiliterate pedagogy offers teachers opportunities to explore the multiplicity of communication channels in the classroom while acknowledging the saliency of cultural and linguistic diversity. It includes engaging in multimodalities (audio, visual, spatial, kinesthetic) and multiple literacies in classroom instruction. Through this approach, the teacher integrates music, movies, art, and a wide range of digital resources to deepen students' engagement with content, reading/viewing/listening to diverse materials and creating texts and representing ideas in

multimodal formats. Cope and Kalantzis (2015) describe the multi of multiliteracies as "enormous and significant differences in patterns of communication" in global contexts (p.3).

Given the new BC's curriculum focus on creating more holistic experiences for students, an introductory multiliteracy course is an opportunity for teacher candidates (TCs) to use multimodal texts to share experiences, ideas, explore their world and extend the same to their future students. Through a multiliterate course, TCs have opportunities to acquire a breadth of literacies to create more equitable and socially just learning spaces. They can recognize literacies in their disciplines, make connections across disciplinary areas and strengthen their understanding of literacies. That said, these are anticipated outcomes for most TCs' participation in a multiliteracy course; this is not always the reality for some, especially those from the sciences and math, who struggle to make the transition from discipline specific teaching. This led to the researchers' current investigation to find out how better to engage TCs from science and math backgrounds in multiliterate pedagogies and practices.

### *Rationale*

For decades literacy educators have experienced significant challenges instructing secondary TCs in literacy practices in their content areas (Ansty & Bull, 2018; Moje, 2008; Spitler, 2011). Research shows that pre-service mathematics and science teachers are particularly resistant to literacy-based university courses (Darvin, 2007; Gee, 2008; Moje, 2008; Ng, 2012; Patterson Williams & Monte-Sano, 2020; Spitler, 2011). The limited literature available suggests many of them see literacy teaching as the job of the English or literacy teacher, and as such, demonstrate little enthusiasm to engage in literacy practices (Gee, 2008; Moje, 2008; Spitler, 2011). Further, they generally do not see literacy practices modelled by science and mathematics teachers during their school-based experiences. Of note, much of the existing literature focuses on younger children, English language learners, pedagogy and learning design (Allison & Golston, 2018; Hauaner, 2008; Kumagai & Lopez-Sanchea, 2016; Kumpulainen & Sefton-Green, 2020); little research has focused on teachers who draw from a science/mathematics domain. The researchers, Kathy and Tanya, also experienced similar challenges in teaching the course *Multiliteracy across the Curriculum* for several years. Kathy has been teaching the course in the secondary teacher education program for a decade, and was more recently joined by Tanya, who is working as a sessional instructor. Both of us come with literacy backgrounds, have extensive experience as classroom teachers, and are committed to working in transdisciplinary ways, hoping to assist TCs in navigating the complex worlds of school. Through collaborative efforts, we worked to connect the course we teach with other campus-based and school-based experiences of the TCs during the same term and throughout their programs. Despite extensive planning and collaboration to develop an engaging course, some mathematics and science-based TCs were resistant and sometimes exhibited poor attitudes to adopting a multiliterate approach in their future classrooms. Spitler (2011) argues that some TCs might be resistant to what is considered arts-based approaches due to TCs firmly embedded identities that are resistant to literacy teaching in disciplines driven by linear and experimental approaches. This was the challenge for both of us.

Before the COVID-19 pandemic shut down all face-to-face learning opportunities, we worked to create relevant, engaging, and multimodal experiences in our classes. The course drew on Indigenous principles and notions of transdisciplinarity as well as personal and professional identity development, with the recognition of the complex and diverse contexts of learning in today's schools. In order to address the need to develop an awareness of their budding teacher identities, we had TCs create short "Who am I?" videos that represented their prior experiences, passions, and aspirations. They shared these with their instructors and colleagues and offered feedback to each other related to both the ideas being shared and the effectiveness of the video formats used.

In addition to the video, TCs (who spent time each week in a high school, visiting teachers and engaging with students) developed a multimodal case study reflecting on who their 21st students were, a multiliteracies thematic learning plan and a final reflective writing on their teaching and learning experiences. In the final face-to-face iteration of the course before COVID, Kathy's class worked with high school students in a local school to co-create a multimodal project that focused on Climate Anxiety. Many TCs and high school students developed exciting and meaningful projects that were displayed around the school and in the community. However, despite the integrated projects involving high school students and multimodalities, a few of the TCs were displeased, looking for a more utilitarian approach to teaching that focused specifically on their disciplinary focus. It is also important to understand the context of the TCs' program and recognize some of their stresses in the face of new learning challenges -- the course was taught in a face-to-face format on campus, with opportunities to connect to schools and community, amidst five other courses they were taking during the term -- a heavy workload.

With these contexts in mind, and the shift to online teaching in 2020 due to the pandemic, Tanya began noticing a change in attitude among her math and science TCs during that year. TCs were noticeably more positive in their attitudes toward the course and showed much enthusiasm for the content, unlike previous years. Many science and math TCs appeared to be developing new literacy identities through active engagement in classes, openness to exploring multiliterate approaches and demonstrating enthusiasm for the course. Tanya shared her observations with Kathy. These observations led us to question what factors were influencing the math and science TCs' change in attitude and how we could extend on these to foster instructional engagement and expand contemporary literacies for all students. Most students' favourable reviews of the course in 2020 further spurred our curiosity as we were accustomed, in past years, to a few students (most often aligning with the sciences and math) indicating that they did not find the content relevant to their subject disciplines. We wondered how the pandemic and online teaching itself impacted students' attitudes towards the course and might have shifted their experiences and literacy identities. Given the new opportunities that were created as a result of teaching the course online, we needed to act on these to create more transformative practices that would allow all TCs to see themselves as literacy advocates. It was also essential to understand how new literacy identities were being formed for all of the TCs and what strategies literacy educators could develop to nurture these. The following theoretical

perspectives help us in better understanding the shifting conditions and ways in which we could shift our own pedagogical practices.

### *Theoretical Perspective*

The continual shifts in communication in the 21st century have called for changes in how teachers engage students. In contemplating the future of literacy pedagogy, the New London Group coined the term 'multiliteracies' to address the 'variability of meaning-making in different cultural, social or domain-specific contexts (Cope & Kalantzis, 2015, p. 3). A multiliterate perspective meant a significant shift in literacy teaching from a focus on rules of standard forms of language to how learners negotiate meanings (New London Group, 1996). Cope and Kalantzis (2009) contend that meanings are made in increasingly multimodal ways, and so literacy pedagogy should be extended to privilege multiliterate approaches that are relevant to students' needs in the 21st century. They suggest that educators bring multimodal texts, particularly those typical of the new digital media, into the curriculum and classroom to allow learners to move between representations in texts. The underlying principle of this reasoning is that learning is a reflexive process that requires multiliteracy educators to be weaving in and out of different knowledge processes. Through reflexive pedagogy, the multiliteracy educator embraces students' life worlds, immerses them in their experiences, puts meaning to their knowledge, and transfers them to different contexts and cultures (Kress & van Leeuwen, 2001). These ideas extend on Vygotsky's and Bakhtin's notions of socio-cultural learning, wherein learners are seen as active agents in learning through their use of language and interactions with others. Vygotsky (1978) theorized that speakers' social, historical, and cultural systems are key parts of their language socialization and the different language decisions they make daily in their communication with others. For Vygotsky (1978), this means that language is in process, constantly changing and growing as we interact with different groups over different periods in our lives.

Given Vygotsky's theory that learners' social and cultural practices are central to their learning and that their language is constantly changing, an inclusive multiliterate pedagogy that allows for diverse learner voices is most plausible. In his opening conversation on inclusivity and diversity in literacy practices, Dei (2019) asks the critical question, "How can we transform education systems in positive and inclusive ways if we do not critically identify, examine, and change the socio-political and cultural systems that continue to exclude so many?" (p.1). Within the contexts of this research, this is a call to action for educators across all disciplines who continue to replicate literacy practices that fail to acknowledge multiliteracies across cultures, social structures and identities. In support of this, Spitler (2011) contends that:

In order for pre-service teachers' beliefs to shift regarding the content area or disciplinary literacy instruction in secondary social and cultural contexts, teacher educators should focus on the literacy identities of the pre-service teachers in their classrooms. In other words, educators should make a concentrated effort to understand how prospective teachers see themselves as members of a literacy

discourse community (Gee, 2008), and how they envision and enact literacy instruction in support of adolescent literacy development (p.306)

Magro (2019) and Kuly (2019) propose that educators adopt transcultural literacies that transcend borders and have the potential of advancing even more meaningful teaching and learning experiences. Kuly (2019) reasons that a transformative transcultural multiliteracy curriculum built around students' voices, stories, hopes and challenges is critical in our classrooms. These approaches provide avenues for students to engage in a wide array of ways to communicating their understandings and engagements in the world -- diagrams, videos, storytelling, biographies, collages, podcasts and images can be catalysts to express themselves. Kuly (2019) further asserts that thoughtful and reflective teaching requires direct action to undo naturalized inequity that has become commonplace in schools. He notes the urgency of creating a more positive inclusive vision of education that utilizes diverse modes of representation in all areas of students' learning. This transformation, however, can be challenging when working with TCs from some disciplines. Darvin (2007) observes that TCs from the sciences and math were often disgruntled with taking his *Language Literacy and Culture in Education* course that they considered a complete waste of time. He reported that:

The students who complain the most and see the least relevance between the course content and what they perceive they *should* or *will* be teaching, 9 times out of 10 come from one of two programs, science or math education (p. 246).

Several critical sources have identified some math and science TCs' reliance on one prescribed text for the course, emphasis on getting correct answers, and no time to deviate from course content as factors often impacting their resistance to literacy-based courses (Burns, 2005; Darvin, 2007; Magro, 2019). Darvin (2007) further theorizes that the challenges literacy educators experience with math and science TCs result from the pedagogical strategies they have witnessed that have greatly influenced how they believe math and science should be taught. In a sense, it is a world that has no place for literacy, which might result in some TCs constructing identities that do not embrace literacy in their subject disciplines.

Berzonsky (2011) posits our concept of self is vital in identity construction as our agency plays an active role in our ability to mold our own identities. That is, identity becomes a "process in which one governs and regulates the social-cognitive strategies they need to construct, maintain and reconstruct their identities within their social constructs" (Berzonsky, 2011, p.55). It can be argued that if TCs' embedded identities are constructed in ways that are contrastive to literacy practices, then it is likely they will find it challenging to adopt some of these practices in their classrooms. However, identities are fluid, constantly changing and open to contestation. As such, some TCs' established identities can likely evolve as they challenge their own prior socialization. In this case, it is possible for them to develop a literacy identity wherein they construct 'self' as multiliterate educators

A transdisciplinary approach by literacy educators is necessary to foster TCs' literacy identity and dismantle the discipline-specific focus impeding students' growth (Davis & Phelps, 2005; Klein, 2015). This approach seeks to disband the boundaries between disciplines as learners immerse themselves in the more seamless integration of contextual knowledge. It allows students to make connections across disciplines and add greater depth and complexity to their learning. It provides opportunities for TCs to develop the ability to relate to a constantly changing array of people from different backgrounds. It is also having a heightened sense of awareness that learning is ongoing and as such, learners need to know deeply, apply conceptual structures developed in one field to another. In sum, through transdisciplinary lenses, the learner begins to understand the interplay between knowing, doing and understanding across perspectives and disciplines.

### *Research Design*

We often engage in ongoing assessment with our TCs, with each other, and in a self-reflexive way to optimize students' engagement in the course. In most of our dialogues, the outcome of TCs' learning was at the fore as we brainstormed ways to increase course relevancy and depth of understanding for all. Social constructivist and transdisciplinary theories inform our practices, and so it was only natural that we reflected on our experiences through these lenses. A social constructivist approach allowed for open dialogue and consideration of our diverse perspectives and complex experiences. We sometimes mused on the challenges in engaging math and science TCs in the course, and so we were pressed to reflect on our practice through transdisciplinary lenses to find ways to foster instructional engagement. In addition, through social constructivist lenses, we began to orally reflect on our classroom experiences with our TCs to assess factors contributing to initial resistance to the course and recent shifts in attitudes. As Creswell (2014) advances, social constructivism is an interpretive framework in which "individuals seek understanding of the world in which they live and work" and develop their own meanings based on their life experiences (p. 37). Thus, a social constructivist perspective was important in understanding how we made sense of our experiences and TCs' feedback on their course experiences within our courses. One of the central tenets of social constructivism is that knowledge is constructed and is "contingent on human perception and social experiences "and how one makes sense of their world" (Keengwe et al., 2014, p. 258). Thus, we both embraced the idea that we taught and experienced our courses in different ways as an experienced instructor (Kathy) and one fairly new (Tanya) to the context. We are also cognizant that no two people experience the world in the same way, and we come from diverse backgrounds that influence our own perceptions, expectations, and interactions with TCs.

### *Methodology*

This paper takes a qualitative and interpretive approach as we accept that there is no one way of seeing the world and representing points of view. As Mair and Frew (2018) iterate, we also accept that we bring with us "perspectival understandings, biases, pre-understandings and practices" that will likely impact how we see our experiences (p. 215). Thus, to reflect on TCs' experiences in our Multiliteracies course, we engaged in a duo-ethnographic study of our shared past course experiences with math and science TCs in the

course and Tanya's recent experiences with seven science and math TCs in her 2020 online course. Through duo-ethnography, we engaged in dialogue of our disparate and similar experiences to reflect and interrogate our experiences with some students in the course. Denshire (2014) describes duo-ethnography as a co-construction of narratives wherein two or more researchers dialogue their personal experiences with a shared phenomenon. Mair and Frew (2018) postulate that the two individuals compare their experiences with each other during the dialogue, in essence becoming both the researcher and the researched. In this case, we took time to explore our personal experiences as these become a conscious part of what we would study. The duo-ethnographic approach, embedded within students' feedback, was critical in understanding how the current educational climate (the pandemic) impacted some students' literacy identities.

### *Course Description*

The course "Multiliteracies Across the Curriculum," aims to prepare prospective secondary school teachers to develop understandings and approaches to integrating literacy processes and products into the subject disciplines. It aims to enable TCs to better understand:

- Multimodality, complexity and interconnectedness of our 21st-century classrooms;
- 21st-century conceptions of text, literacy, multiliteracy and multiliteracies pedagogy;
- ways in which they are multiliterate as well as understand who their students so as to effectively utilize multiliteracies for their students in diverse classrooms and disciplinary areas;
- uses of different tools to engage their students in their learning and their different world(s);
- multimodal texts in a variety of ways, both engaging with them and creating them;
- how multiliteracies support curriculum and curriculum change and develop pedagogies and practices to utilized multimodalities in authentic ways.

The course examines multiple literacies and contemporary understandings of texts as they apply to learning across the curriculum. It focuses on engaging students in different modalities in their learning with a plethora of digital tools to support learning. Students in the Post Degree Professional program are usually separated into two cohorts, and all students are expected to complete the multiliteracies course during the first semester. In the fall of 2020, Tanya had 29 PDP students in cohort one in her course. Of these 29 students, five were prospective science teachers (chemistry, physics, biology, environmental science), and two were prospective mathematics teachers. The group included four males and three females. All of the students had completed the first degree in their field of study and were undertaking the program to attain their teaching certificate.



In 2020, the course shifted online, although many of the lessons were still taught synchronously. Tanya taught TCs using several digital tools, including AHASlides, Google classroom, Blackboard, and Prezi. Her lessons were also often infused with videos, links, graphics, and photographs, among others. TCs also participated in several digital workshops, including Twine, movie creation, infographics, creating graphic novels, creating and printing 3D images. In addition, Tanya brought in guest presenters from the performing arts, music, Indigenous, and art background to offer TCs varied perspectives of multiliteracies. It should be noted that most of these workshops and speakers are typical of the course experience. The only difference was in 2020, it was taught online and Tanya used tools such as AHA slides to support TCs' learning. Prior to 2020, the course was taught in a face to face format, requiring TCs to utilize multiple modalities for presenting their ideas and creating learning plans. Often Kathy would work on multimodal projects with students and teachers in local schools, museums, and other community spaces. In both formats, TCs were also typically required to present or share their assignments in different modalities.

#### *Data Collection*

Kathy taught the course for many years and Tanya started teaching it in 2017. It is one of those courses many instructors find challenging (engaging students across disciplines), but we embraced and engaged in many planning sessions to improve students' course experience. Tanya shared with Kathy, who wasn't teaching the course that semester, that the math and science students were exhibiting very positive attitudes in the course. We both thought it was an exciting development. So, Tanya started documenting (saving to a word document) students' verbal reflections on the course during Zoom classes. Next, the authors began dialoguing about Tanya's new experiences in the course, guided by several open-ended questions: What are math and science TCs' experiences with the course? To what extent did the pandemic and online teaching impact TCs' attitude to the course, and how have TCs' attitudes and identities shifted during the course? Later, students' (22) anonymous course survey responses were saved to a pdf file for our perusal during our reflections. We also reflected on our experiences in the last three years/courses to determine what was significantly different about TCs' attitudes and practices compared to the 2020 group. Tanya then collated both researchers' oral reflections, noted the recurring ideas in our experiences, and then compared these to her shared experiences in the current semester to determine how students' experiences, attitudes and literacy identities might have shifted during the pandemic.

#### *Emergent Themes*

This section invites readers into our thought processes as we ponder the complexities and nuances of teaching multiliteracies and multimodalities to TCs from various disciplines. To allow for directionality, the emergent themes are organized with respect to the crafted research questions: What are math and science TCs' experiences with the course? How did the shift to online delivery as a consequence of the pandemic contribute to TCs' attitude to the course? And, how have TCs literacy identities shifted during the course? Each section seeks to delineate and explore our reflections on these questions.

*What are math and science TCs' experiences with the course?*

In 2017, in one of Tanya's course surveys, a TC wrote, "I have no idea why I have to spend an entire semester doing this course that is of no relevance to math. What I needed to know I could have done in two weeks." In the following year another student indicated in the review of Author's 2 courses that the "Course is irrelevant to his teaching and learning." In our oral reflective sessions, the authors reflected on comments like these and noticed that we had similar experiences and course reviews from some TCs. While the course survey is anonymous, some TCs' choice of words such as "no relevance to my content area" often suggests that those TCs might be in the sciences or math. Further, through the shared stories of our experiences in the course over the three years, we both realized that our past math, physics, and chemistry students were the most resistant to our multiliteracy course.

Kathy hypothesizes that "TCs who come into the program lacking confidence and sense of self, unwilling or unable to adopt a 'growth mindset' or ability to be adaptable and flexible, were more fearful of multiliterate practices and approaches that challenged their prior conceptions of 'teaching' and their role as teachers." Tanya agrees but also considers the possibility that some TCs enter the program with the perception that they will be learning methodologies and strategies directly related to their disciplines and so might not be able to envision themselves engaging in literacy practices in their own classroom. It is also plausible that as educators, our teaching approaches might have failed to transform some TCs' views and practices. For instance, in Tanya's 2020 course survey, 82% of the respondents selected 'excellent' to the question "The course provided opportunities for you to become more engaged with the course material for example, through class discussions, group work, student presentations, online chat or experiential learning." That was a significant increase from 67% the previous year. One TC wrote, "The lessons were clear and practical. I could imagine myself using the multiliteracy strategies in my classroom, something I didn't think was possible for my subject area" (course survey 2020). This comment suggests that the TC is likely from the math or science discipline given that TCs from the arts and humanities are more likely to imagine multiliteracies as a part of their classroom. This experience of increased course relevance is also a shift from some of the initial comments at the beginning of the course. A perusal of Tanya's notes from TCs' verbal responses to the course reveals some concerns at the beginning of the course that it might not be relevant to their subject discipline. For instance, in the first lesson, TCs were asked to indicate their expectations of the course, for which a few science-based TCs admitted that while they look forward to learning new multiliterate strategies, they were still not sure how these would be used in their discipline.

These iterations suggest that instructional engagement was important to some TCs' participation in the course. In some ways, the onus is on the teacher educator to effectively demonstrate how TCs across disciplines can integrate multiliterate pedagogies in their classrooms. There are increased pressures on teacher educators to prepare TCs to bridge the gap between traditional literacies, multiliteracies, and multimodalities (Ajayi, 2010; Patterson Williams & Monte-Sano, 2020; Rowsell et al., 2008). As such, as instructors of the course, we are compelled to interrogate our pedagogies to determine the changes

needed to make the course more accessible to all learners. In many ways, we are being challenged to provide our students with richer learning experiences that can translate into their future classrooms. Rowsell et al., (2008) propose that teacher educators develop a new pedagogical vision of teacher preparation that opens up participation for students across all disciplines. As we reflect on Tanya's experiences with the 2020 cohort, we had to consider what new pedagogical strategies and methods of communicating the course content we needed in future classes to shift math and science students' attitudes to the course and their engagement. We also had to consider how to accomplish our vision or goal of having all TCs develop multiliterate pedagogies at the end of the course. Ajayi's (2010) research on pre-service teachers' perception of their preparation to teach multiliteracies and multimodalities revealed that pre-service teachers had mixed views regarding their preparation to engage in multiliterate teaching. Ajayi's (2010) research revealed that while some pre-service teachers felt their instructors were making a concerted effort to engage them in practical applications of multimodal tools, others felt teachers and their program were not adequately preparing them to teach multiliteracies. In some cases, teacher educators were challenged to leverage various digital tools in their classrooms to better prepare pre-service teachers to meet the demands of 21st-century learners. There is some evidence from Tanya's 2020 class that greater access to digital tools can impact students' engagement with the course. For example, the 2020 class was exposed to more practical use of digital tools in teaching as Tanya had to use them in her actual teaching. This exposure might have also influenced the 2020 cohort's overall positive outlook on the usefulness of the course content. Given some TCs' responses in previous years that the course content was irrelevant, it is important that the content was just as valuable as our methodologies. In our conversations, Kathy also noted that in her course pre-2020 digital tools were used to create videos and multimodal presentations, in the context of TCs planning and for campus-based instruction; LMS platforms were also utilized, particularly Google Classroom. As such, Kathy contends that it is more likely that some of the math and science TCs were exposed to textbook-focused, teacher-directed lessons as that approach is still a norm in many BC high schools.

*How did the shift to online delivery as a consequence of the pandemic contribute to TCs' attitude to the course?*

The pandemic brought to the fore schools and teachers' ability or inability to adapt to changing learning contexts quickly. As we examine the contributory factors to some TCs' entrenched views about literacy approaches in their disciplines and why some math and science students' attitudes differed in the 2020 course, we had to consider how the pandemic might have impacted these attitudes. The closure of schools and the shift to online learning generated immense concern about students' disrupted learning. To mitigate learning loss, many schools have shifted to online learning. This shift means teachers have to create alternative means to continue students' educational growth and engagement in learning amidst a growing crisis. Reimer (2021) reported that an assessment of educational strategies used to support students during the pandemic left many questions about the efficacy of the strategies and educators' capacity for rapid innovation. He further noted that the daily interruptions to online learning and the emotional strain of the pandemic left many students and teachers at odds with curriculum outcomes. Teachers now have to grapple

with how to nurture students' independent learning skills for learner continuity during the pandemic. Kathy reasoned that given TCs' weekly Wednesday visits to high schools in the school districts, they would have been aware of all these challenges and were likely considering how to mitigate these in their future classrooms. This awareness might have also heightened their engagement and enthusiasm to acquire new multiliterate strategies. For instance, Tanya noted that a few of the science TCs were the first in the Zoom classes each week; they asked many questions, shared responses and produced really good videos and Twine stories for their assignments. For example, one science TC developed a Twine story to teach about electricity. Further, Tanya observed that in group teaching presentations, some TCs from math and science used the graphic novel to demonstrate science processes, created canva posters and shared assignments projects that would require K-12 students to use multiple modes (letters, graphic novels, videos, podcast) to share their learning. These were notable differences in practices and attitudes to some math and science TCs in previous years. In past course conversations, it was quite common for the usual one or two math and science candidates to express their frustrations with the course to instructors Tanya and Kathy.

For the authors, the challenge was how to change these perspectives that were also evident among our TCs. During Zoom sessions, the TCs and Tanya had many conversations about the pandemic and how it has shifted how students learn. Tanya saw this as an opportunity to have conversations about how their perspectives and approaches would need to change to meet the new demands of students, especially during the pandemic when many students were experiencing Zoom fatigue and were becoming more disengaged with learning. Tanya and students often brainstormed ways to address these issues. In some conversations with Tanya, TCs shared their sense of urgency to acquire new teaching tool kits to meet the increasing demands on teachers. Tanya's notes also revealed that TCs' ongoing reflections during the course showed increasing positivity as they began to use some of the tools to demonstrate their learning. These conversations and some math and science TCs' enthusiasm to try out new digital tools in the course and literacy strategies led Tanya to presume that the shift in the demand on teachers during the pandemic and increased exposure to technological tools might have been impacting TCs' positive attitude to the course. It is conceivable that TCs would want to acquire as many digital tool kits and strategies as possible to be better able to function in an online world of teaching and so were enthusiastic to learn more. In addition, it seems some TCs had begun to unpack how some of the literacies explored in class might be useful in different disciplines and across different platforms. For example, one of the requirements for the course was for TCs to write blog posts about their use of multiliterate strategies in practice and to design a multiliterate tool to aid their students in learning a concept. Many of the blog posts revealed that TCs were integrating tools from their subject discipline, such as mapping in Geography with digital story-telling and using graphic novel panels alongside models of climatic changes. TCs were also happily sharing their acquired knowledge with other peers who then reached out to Tanya to get further details on how to use some of the tools. Again, some of these tools are not new to the course, and it is likely that this group of TCs are exceptional learners who are generally enthusiastic about learning. As mentioned in the course description, using digital tools to meet 21st-century learner needs is an essential part

of the course content. Through these new experiences, TCs are introduced to several digital tool kits such as teaching through digital story-telling, creating graphic novels as tools of engagement, developing video presentations and lessons to share with students via online format, using Google Jam board to facilitate learning and many other tools. These, in some ways, would have opened up possibilities for TCs on how they can engage their students were they to teach in an online format.

As Bob, a pre-service teacher in Spittler's (2011) research with TCs reported at the end of his multiliteracy course, it offered him a "new ways of looking at understanding, at meaning, at engagement and literacy itself wrapped around those things" (p.307), so too did a few of Tanya's science TCs. One science-based candidate reported she was "skeptical at the beginning of the course, but learned some interesting ways to embed literacy in the science curriculum." She further stated that she was "terrified of the idea of teaching online but felt more comfortable after teaching sample lessons in the class and trying out some of the multiliterate strategies and tools we explored" (in-class communication). It seems the TCs' participation might have increased when they were faced with the possibility of teaching online and having to develop multiliterate strategies to keep their students engaged irrespective of the subject disciplines. Throughout the pandemic, teachers working in hybrid ways were required to utilize digital tools, modelling their use in all types of classrooms, thus creating credibility for the multiliteracies instructors that had not previously existed. Kathy, in discussion with numerous teachers during this time, noted them reporting a much greater range of teaching tools and pedagogies in all disciplines. The ability to use textbooks was not as prevalent as high school students did not have access to them, and in shifting to three-hour classes, TCs and teachers had to find diverse ways to engage their learners. In past reviews for both authors, course applicability and meaningful engagement were high on students' concerns about the course. Thus, it can be assumed that the changing demands on teachers as a result of the pandemic might have increased TCs' sense of urgency in using multiliterate and digital tools.

#### *How have TCs literacy identities shifted during the course?*

Ajayi (2010) purports that "how pre-service teachers perceive their learning experiences and how they conceptualize their roles in the teaching and learning are important for designing curricula pedagogies" (p.12). Thus, it can be reasoned that if TCs are coming out of disciplines outside of literacy education, they will have to perceive themselves as multiliterate educators to design multiliterate curricula. This can be challenging for some TCs. Our reflections and ongoing conversations revealed that our chemistry, physics, and math TCs were more likely to have teacher identities that did not embrace literacy practices in their classroom spaces. We noted this was likely due to the lack of emphasis on literacy practices and approaches in their undergraduate programs where a different conception of 'knowledge' and 'learning' drives the programs or in their other teacher education courses. As a result, this paper advocates for a shift in teacher education courses across the curriculum to promote critical literacy and models of literacy practices for all TCs. For math and science TCs to successfully navigate teaching in the 21st century, they can consider embracing a pedagogy that mediates students' meanings in learning and creates equitable opportunities for all to participate. One way of doing this is

by adopting a multiliterate identity as a teacher. For instance, TCs could imagine themselves as literacy advocates and change their practice to reflect this.

With these thoughts in mind, we reasoned that self-reflection within the classroom space, providing opportunities for TCs to work with peers from other disciplinary orientations, to take risks with multimodal approaches, consider the complex and unique needs of their future students, and applying multiliterate strategies in authentic contexts were important in shifting identities. Over the years, the authors worked hard to create a sense of community within their classrooms, wherein TCs could imagine themselves as literacy advocates. In the course survey, one TC remarked, "Tanya was exemplary in her ability to create connections with students and to create a positive atmosphere (even over zoom!!). Spending time in her lessons was certainly the bright spot that we needed during these times. I learned so much about multimodal teaching just from observing her practices." A recollection of TCs' comments over the past three years also suggested that creating a sense of community (via "Who am I?" videos) weekly check-ins, establishing classroom support groups and setting aside time to share 'did you know' moments about self in multimodal ways helped to build classroom community and multiliterate identities. For instance, as the 2020 cohort classroom rapport increased, so too did their engagement in the course and affinity for multimodal discourse. During Tanya's 2020 class, TCs were often encouraged to find and share new multimodal strategies they discovered throughout the week. They would enthusiastically share out their new discoveries. This was usually received well by their peers, and there was even lighthearted competition among the group as to who could find more multimodal strategies. Similarly, Ajayi (2009) observes that when TCs are exposed to multiple literacies across social, cultural and national boundaries, it provides many opportunities for them to reconceptualize their identities as literacy educators. It was evident from these experiences that TCs were cultivating literacy identities. Prior to 2022, strong community among the TCs developed in their cohorts, but the opportunities to observe practicing math and science teachers using multiliteracies was not as prevalent. The need for teachers to adopt multimodal approaches and texts offered models that they had not previously used or valued. Given the new BC curriculum's push to have teachers adopt and appreciate a holistic breadth of literacies, it is critical that TCs develop and foster their literacy identities. These new insights will also allow for more integration of content across disciplines, given that multiliteracies approaches, aligned with competency-based and personalized learning, require that TCs release their control of content and transmission of information.

### *Conclusion*

TCs' course experiences and our reflections on our practices have implications for how the multiliteracy course is delivered. It is important to understand TCs' literacy identities to develop purposeful course content and strategies that are applicable in their classrooms. There is also a need for more authentic course experiences, transdisciplinary thinking, teaching and community-building within the classroom. It was evident that Tanya's 2020 instructional engagement impacted TCs' response to the course, thus leading us to conclude that the online teaching platform was a unique opportunity to create more transformative practices that allow all TCs to see themselves as literacy advocates. It is

also important to note that there have been significant societal shifts in recent years, not only to online experiences but also by way of inclusion. We are all being challenged to respond to the needs of all of our students. Linguistic diversity, global awareness, self-awareness, empathy, resilience, learner empowerment, and significant personal and social changes are happening every day in our classrooms, and so it is imperative that our TCs are equipped to take on these challenges (Magro, 2019).

The pedagogical conversations with TCs are shifting as they realize the importance of using a range of tools and strategies, approaching 'content' in an inclusive way, and considering diverse perspectives and cultural values. Although we have only one year's online experience to reflect upon, we have noted that a few TCs in their 'back to normal' face-to-face environment in 2021 are again somewhat discipline-focused and more dismissive of the inclusivity that multiliteracies bring in the early stages of the course. At the onset, a few students showed the usual resistance to a multiliterate approach in the math and science disciplines. This attitude brings us back to Kathy's earlier observations that some students have developed identities that are rooted in linear structured practices within their undergraduate program that have left them feeling unconfident as multiliterate advocates, especially in assessment. While instructor engagement and mode of delivery might be factors in TCs' initial resistance, the gradual positive shift in the 2021 cohort's attitudes over the course duration suggests that a predetermined literacy mindset might be a significant factor at the onset. However, as the course progresses and vestiges of multimodal remain evident in high school classrooms during the pandemic, teachers themselves have shifted their approaches, which is a critical element in TCs valuing diverse practices and tools. Now some of the 2021 cohort of science and math-based students are keen to employ multiliterate pedagogies. For example, one math student in the 2021 cohort demonstrated enthusiasm for the course and has sought to develop multiliterate ways of engaging and assessing students. The student often connected with the instructor to discuss ways to approach content differently. These recent experiences and the findings from the 2020 group still leave us with many questions about our future practice. Although the 2021 classroom practices are quite similar to 2020, and a highly positive community is observed among the cohort, we are still questioning why some students are resistant to the *Multiliteracy Across the Curriculum* course and what can be done at the department, faculty or even university level to change this. We cannot determine whether the 2020 group was an anomaly or whether the online approach adopted by Tanya changed how TCs were able to value interconnected learning but believe this is an important avenue of research to continue.

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