Enhancing STEM Education: Integrating Collaborative Technologies in Micro-Teaching for Pre-service Teachers

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Abstract

This full paper explores the implementation of computer-supported pedagogy in STEM (Science, Technology, Engineering, and Math) teacher education at two Canadian universities: Mount Saint Vincent University, Halifax, Nova Scotia and University of British Columbia, Vancouver, British Columbia. We summarize key findings from our study on the use of collaborative technologies in micro-teaching as part of implementing pedagogical innovations in our STEM methods courses for K-12 preservice teachers.

Micro-teaching in Initial Teacher Education (ITE) programs involves short-duration teaching sessions conducted by preservice teachers with their peers as students. Over the course of three years, we implemented a micro-teaching approach involving more than 300 elementary science and secondary STEM preservice teachers at these universities. We leveraged three web-based collaborative technologies, WeVideo, CLAS (Collaborative Learning Annotation System), and WeVu (commercial version of CLAS) to facilitate the series of explicit scaffolding of micro-teaching.

WeVideo, a user-friendly online video editor, served as the platform for recording, editing, and enhancing the micro-teaching videos. These videos typically ran for three to five minutes. Subsequently, these videos were uploaded onto WeVu, another web-based platform. WeVu enabled preservice teachers to share their micro-teaching videos, engage in time-specific and general comments, and assess one another's work either synchronously or asynchronously.

Using a qualitative thematic analysis of preservice teachers' anonymous exit slips and course reflections, we generated three overarching themes as our key findings. These themes highlighted the growth and development of preservice teachers' technological, pedagogical, and content knowledge (TPACK), reflective practices as future K-12 STEM teachers, and the promotion of access and equity of educational technology in STEM education. We suggest that more longitudinal case studies with quantitative and qualitative analyses are needed to further explore what aspects of STEM preservice teachers' subsequent teaching practicum might be enhanced by the use of collaborative technologies during the micro-teaching in the STEM methods courses in teacher education.

Introduction

This full paper on computer supported pedagogy serves as a medium of exchange for innovative applications of educational technologies in education. We report the findings of evidence-based research [1] to inform curricular and pedagogical initiatives for students and teachers' development particularly in the context of the post-secondary Initial Teacher Education (ITE) programs in STEM (science, technology, engineering, and mathematics) education.

The paper describes what we have learned from using these innovative technologies in methods courses with preservice STEM teachers in Canada during the COVID-19 pandemic. Our overarching research focus revolves around the question: **What did STEM preservice teachers learn throughout the design, creation, and implementation of micro-teaching and micro-teaching videos using collaborative technologies?** These learnings framed and drew our attention to: 1) expanding preservice teachers' technological, pedagogical, and content knowledge (TPACK), 2) nurturing and strengthening a community of preservice teachers as reflective practitioners, and 3) addressing the issues of access and equity through creative use of collaborative technologies.

These learnings began by reimagining micro-teachings through the use of collaborative technologies namely, WeVideo, WeVu (both were used at Mount Saint Vincent University), and Collaborative Learning Annotation System (CLAS) [2], an original version of WeVu based at the University of British Columbia. We framed the implementation of these technologies through the lens of Deliberate Pedagogical Thinking with Technology Framework (DPTwT) inspired by TPACK and Community of Practice (COP) frameworks.

We argue that the development of preservice teachers as reflective practitioners should start way before the long-awaited school practicum. To help future teachers gain experience and build confidence in STEM teaching, while becoming reflective practitioners, we suggest integrating collaborative technologies in micro-teaching sessions during the STEM methods courses.

Reflection in Initial Teacher Education Program

The importance of promoting reflection and reflective practice in ITE programs is widely acknowledged [3-5] with research conducted in Scotland and Australia serving as our primary references, and examples from Canada. For instance, the General Teaching Council for Scotland [6] underlines the importance of reflection by providing opportunities for future teachers to reflect on and act to improve their own professional practice. In addition, the Australian Institute of Teacher and School Leadership [7] requires all ITE programs to implement a teaching performance assessment that includes a reflection of classroom teaching practice including the elements of planning, teaching, assessing, and reflecting. In Canada, the Association of Canadian Deans of Education's General Accord [8] strongly emphasizes the importance of reflection in ITE programs through the development of "situated practical knowledge, pedagogical knowledge, and academic content knowledge, as well as an introduction to research and scholarship in education" [8]. The Accord expects that all ITE in Canada provide opportunities

for preservice teachers to interweave the contemporary theory, research, and practice. One of these opportunities is offered during their school-based teaching practicum, a major component of ITE programs which is often most valued by preservice teachers [9]. In the school practicum, preservice teachers develop their competence in planning, teaching, classroom management, and evaluating lessons as they continue to "observe, discern, critique, assess, and enact inclusive curricula and pedagogies" [8].

The school practicum is rooted primarily in critical frameworks on reflective practices [10, 11] and CoP [12]. These frameworks underpin both individual and collective knowledge being generated by doing [4, 5]. As preservice teachers plan, rehearse, deliver, and evaluate their lessons while being mentored by their associate teacher (also known as cooperating teacher or school advisor) and faculty advisor (also known as faculty or university advisor), the experiences and interactions resulted from these preparations over time develop future teachers' competence and confidence to deal with diverse teaching and learning situations. Such competence also allows preservice teachers to act and respond intuitively (reflection-in-action), evaluate the experience (reflection-on-action) [11], and improve for future implementations (reflection-for-action) [13]. In addition, during the school practicum, preservice teachers' ongoing collaboration with their university practicum advisor, associate teacher, school staff, and fellow preservice teachers allow preservice teachers to acquire and improve their collective knowledge of the nature of learning, the diverse development of their students (intellectual, physical, social, emotional, etc.), professional, social, legal, and ethical responsibility [12].

In the spring of 2020, COVID-19 pandemic brought significant restrictions and changing health protocols that lasted until winter 2023. These changes affected many of Canada's ITE programs and consequently the conduct of in-person and school-based practicum. The shift from in-person to online and/or blended (online and in-person) delivery of classes in K-12, college, and university levels meant that the in-school and in-person practicum had also to be modified into blended delivery. To address this shift, we introduced blended micro-teaching in STEM methods courses with the use of collaborative technologies to support preservice teachers in their subsequent blended school practicum.

Micro-teaching in Teacher Education

Historically, micro-teaching was practiced in the U.S., specifically in 1960s at Stanford University and featured reflective collaborative practices [14]. Micro-teaching in ITE programs are conducted by preservice teachers in their methods courses to improve their planning and implementation of a lesson with peers as students in a duration much shorter than a standard 60-minute class. A typical micro-teaching session would last 10-15 minutes and will be conducted in a smaller group of peers when each one of the preservice teachers teaches a specific part of a lesson to their peers. The planning and implementation of a lesson plan in a micro-teaching context helps preservice teachers to develop awareness of classroom management, classroom routines and practices, time management, and communication skills. Micro-teaching is beneficial for future teachers as it also invites them to experience a lesson as learners, as well as teachers.

We have used micro-teaching extensively in our STEM methods courses before COVID-19. We found them beneficial for pre-service teachers [15]. However, through class responses reflected on weekly exit slips, we found that while engaging with micro-teaching face-to-face has its clear pedagogical advantages, preservice teachers did not have enough time to reflect on each one of the mini-lessons. Micro-teaching is also time consuming and in order to give each preservice teacher an opportunity to conduct it, we had to split our classes into smaller groups. Thus, pre-service teachers could only participate in a few micro-teaching sessions during a class. Finally, it takes more time for a new teacher to notice different pedagogical elements of the lesson and to pay attention to various nuances of the lesson. This was our motivation to start using collaborative digital technologies to facilitate pre-service teacher reflective practice during microteaching.

Our micro-teaching used collaborative technologies namely, WeVideo, WeVu, and CLAS. We started using CLAS in our micro-teaching at pre-COVID, expanded to WeVu and WeVideo during the COVID pandemic, and extended to the present. Our use of these technologies in the implementation of micro-teaching was grounded in Deliberate Pedagogical Thinking with Technology Framework (DPTwT) inspired by TPACK and CoP.

Theoretical Framework

Working with future teachers requires educators to consider not only how to model various pedagogical approaches and pass the knowledge of teaching we have accumulated over the centuries to the next generation of educators, but also how to be creative and open to new pedagogical approaches that incorporate emerging educational technologies. In other words, the key to 21st century teacher education will be continuous teacher growth through ongoing collaboration and use of novel educational technologies. The rapid speed of technological innovations and inevitable failures along the way will leave teachers no choice, but to become members of the educational CoP [16, 17], so the teachers will be able to tackle these challenges together with their peers. CoP [18, 19] is a group of individuals who engages in a process of collective learning, shares a combination of concern and passion for something, and improves members' teaching and learning practices as they interact with each other regularly.

On the other hand, TPACK is an expanded form of Shulman's [20] pedagogical content knowledge (PCK) framework. Shulman emphasized that the nature of teachers' knowledge should link the domains of content and pedagogy as one rather than treating them as separate from each other. The addition of technology into PCK's framework gave rise to the concept of TPACK which consolidates the three forms of knowledge—technology, pedagogy, and content—as an overlapping yet integrated whole of teachers' knowledge of professional growth [21]. TPACK is a framework that addresses the emergence of newer educational technology and complex needs of teachers [22].

While many researchers in modern teacher education have adopted the TPACK framework suggested by Koehler and Mishra [23], in our view, no teacher education program will ever be able to prepare teachers for everything they will need to know to become effective educators.

Thus, from our standpoint, while considering teacher education, TPACK should be only the starting point of the theoretical discussion, while the growth of educators' knowledge for teaching should be the main focus.

In our work, we are guided by the Deliberate Pedagogical Thinking with Technology Framework (DPTwT) [15, 24] that focusses not only on the TPACK teachers have already acquired, but also on their ability to grow this knowledge through ongoing collaboration with peers and experts, while being active members of the joint professional community of practice (Fig. 1).

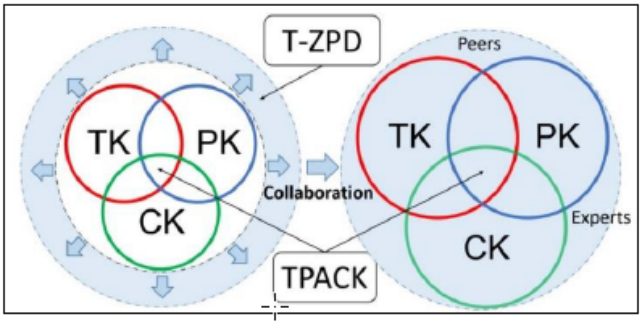

Figure 1: Deliberate Pedagogical Thinking with Technology Framework [24]

The focus of DPTwT framework is teachers' pedagogical growth while deliberately considering the pedagogical advantages and disadvantages of modern educational technologies. Thus, DPTwT framework is especially relevant for teacher education and professional development. Unlike many other educational frameworks that consider the current state of teachers' knowledge, this framework looks at where teachers can get if supported by peers as members of a community of practice. This framework views teachers as learners, thus not surprisingly it considers the Teacher-Zone of Proximal Development [25, 26] as a key element of their professional development. While experts (teacher educators) play an important role in this growth, the DPTwT framework emphasizes the role of peers and the community of practice in this process. Martinovic et al. [24] described it as follows:

> **Creating supportive environments.** To provide adequate scaffolds through a collaborative and technology-based professional learning, the extended DPTwT framework borrows from Engeström's [27] version of the activity theory, which included the components of community, division of labor, and rules … It emphasized that the professional learning is an activity that uses the intelligence of others—evident in tools, discourse, and communal supports—as a lifeline.

Teacher collaboration and working with peers and experts helps teachers utilize "the intelligence of others" to grow their professional knowledge. The process of reflection is a perfect vehicle for this growth. In the next section, we discuss how modern technology can facilitate this collaboration both face-to-face and online.

Collaborative Technology Implementation in Teacher Education

In our teaching, research, and outreach in STEM education with preservice teachers, practicing teaching teachers, K-12 students, and parents for the last decade [15, 28], we saw the importance of collaboration in promoting deeper and more meaningful learning. While the benefits of collaborative learning were comprehensively reviewed [29, 30], the complexity of learning process involved in collaborative learning brought some drawbacks, for example collaboration that involved complicated task or were dependent on individual or group's competence for the task [31]. The advances in technology helped reduce such drawbacks and led to the emergence of learning theories like Computer-Supported Collaborative Learning (CSCL) [32] or DPTwT framework [15, 24], which help to further understand how collaboration with the use of technology can support learning.

Collaborative technologies are Web-based application tools with higher level of accessibilities and functionalities than desktop applications. These functionalities include task-specific, output-oriented, content creation, editing, and sharing both in synchronous and asynchronous modes [33, 34]. In the next section, we introduce examples of collaborative technologies that we adopted in our STEM methods courses particularly in designing and implementing micro-teaching sessions with preservice teachers.

Micro-Teaching Using WeVideo and WeVu

Since 2021, our micro-teaching in STEM methods courses at one of the universities in Atlantic Canada utilized two collaborative Web-based technologies: WeVideo and WeVu. WeVideo [35] is a paid online video editor with easy-to-use editing tools. Videos can be created on any device (Chromebook, Windows, Mac, and mobile). As a cloud-based technology, users do not need to download or software to install and is compatible with popular learning managements such as Canvas, Blackboard, Moodle, Google Classroom, etc. Moreover, while preservice teachers create their videos, the instructor can monitor the progress of the videos and provide comments in real-time. We used WeVideo for preservice teachers to record (the actual delivery and acting out of the micro-teaching lesson), edit, storyline, and layer the multimedia of their micro-teaching. The micro-teaching videos were generally three to five minutes long and uploaded on WeVu [36] for all the preservice teachers in the class to provide comments. WeVu is also a paid Web-based platform that allows the preservice teachers to upload and share their videos, view the micro-teaching videos, and mark them up with time-specific and general comments for feedback and assessment (Fig. 2). WeVu is a commercial version of CLAS (Fig. 3) [2], based at one of the universities in Western Canada, and being used in various disciplines including but not limited to Music, Nursing, Occupational Therapy, Law, etc. Similar with creating micro-teaching videos on WeVideo, providing comments on WeVu can be done either in synchronous or asynchronous mode. In addition, the instructor acts as the administrator who has a full control of the critical settings like privacy, sharing, and access of contents.

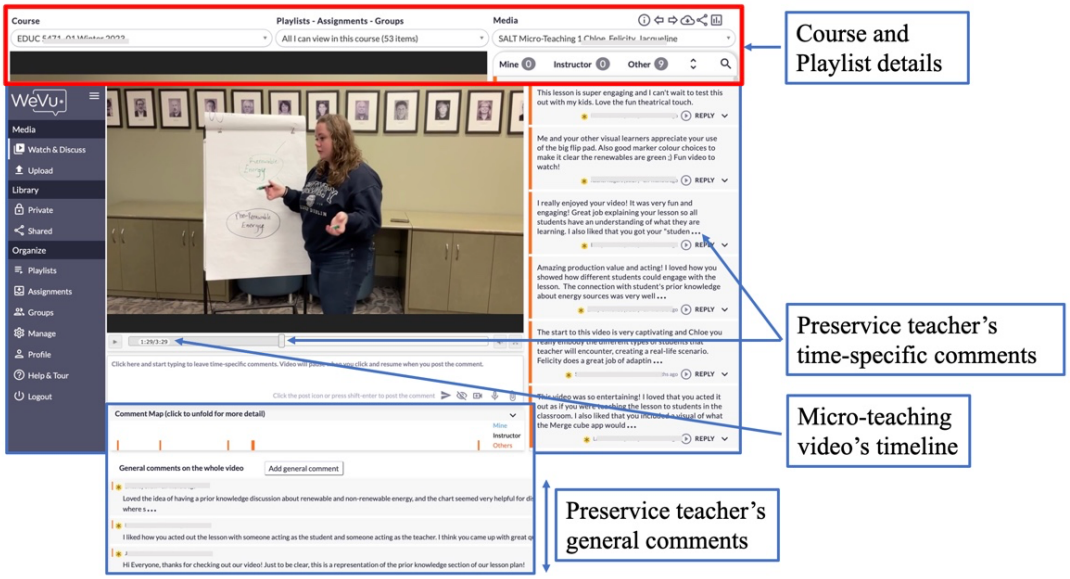

Figure 2: A screenshot of the WeVu Web-based Platform

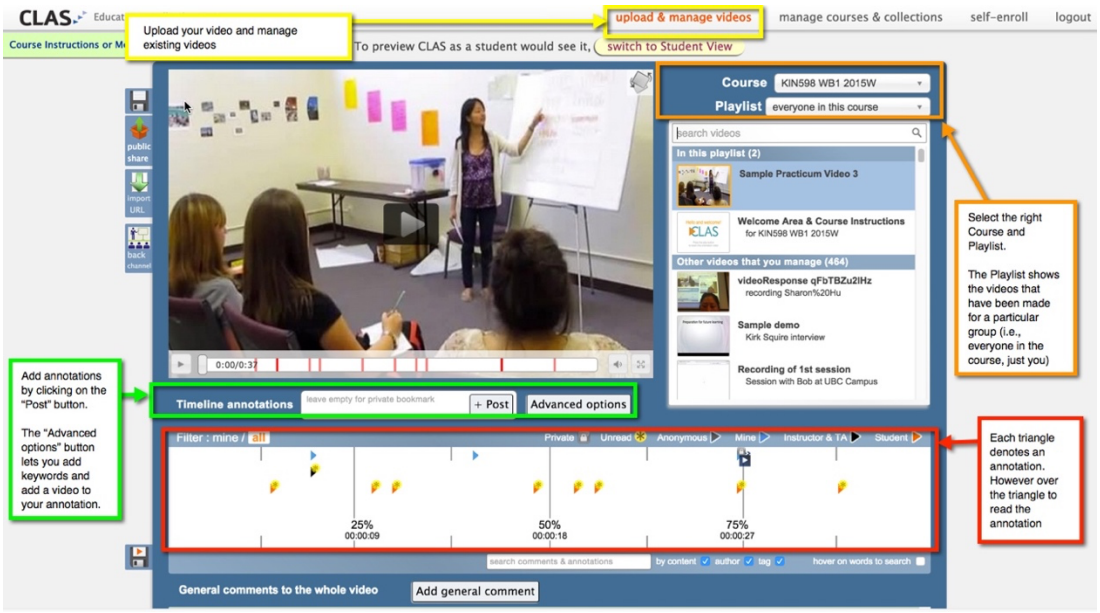

Figure 3: A screenshot of Collaborative Learning Annotation System (CLAS) Web-based Platform

Micro-teaching started by letting preservice teachers group themselves in minimum of two to maximum of five members. As much as possible, we encouraged them to create a group of three members to ensure maximum involvement and efficient planning. From our experience, when the number of group members reaches four or higher, some members would not have enough time to contribute in the conversations. This grouping was particularly helpful in a 12–session course for one term (36 hours in total) and where micro-teaching is just part of the three or four

major output requirements of the course. When grouping was completed, preservice teachers were asked to choose a STEM topic and create a full lesson plan about it for a one-hour class. Then the groups identified specific or critical part of the lesson plan that they would like to highlight in consultation with the instructor. After the consultation, the group began the planning to expand the chosen part of the lesson plan, create a storyline, act out, and record the story in three to five-minute micro-teaching video. Finally, preservice teachers provided comments on their peers' videos and gathered back as a group to assess peers' feedback of their video and reflect on their overall experience.

Methods

Using a qualitative thematic analysis [37], we coded preservice teachers' anonymous exit slips throughout the methods courses from two universities including recorded observations and interactions during micro-teaching and video creation. We provided a list of exit slip questions (see Appendix A), to which preservice teachers respond to in groups (approximately 8-10 groups per class, 6 classes over 2 years) during three-week micro-teaching sessions (constituting 1/4 of the total 12-session course). Additionally, we supplied preservice teachers with a three-level rubric (see Appendix B) to guide them in providing quality and reflective comments. We identified several overarching themes from our coding analyses which were initially conducted and assessed by the first and second authors and then reviewed by the third author. These themes represented valuable learning outcomes from the micro-teaching of preservice teachers using WeVideo, WeVu, and CLAS.

Results

We discussed below several overarching themes as key takeaways from micro-teaching with collaborative technologies.

Development of TPACK and STEM Literacy

Preservice teachers increased their TPACK and developed critical skills of collaboration as they balanced theory and practice in their micro-teachings. Preservice teachers were exposed in the different stages of navigating a consensus in the alignment of theories (motivation, assessment, STEM concepts) to the application of different pedagogical approaches to teaching and learning. These stages included the planning and designing of a lesson plan, justifying activities that will go with the lesson plan, choosing a section of the plan, expanding it for micro-teaching, and acting out the micro-teaching with peers. Such exposures brought increased confidence for teaching, appreciation of the value of reflection, teamwork, and community of practice, and enhanced awareness of the value of theory-informed practice [5, 38].

Moreover, preservice teachers enhanced their skills to communicate, and in the process, acquire critical media and STEM literacy, communication, and presentation skills [28, 39] throughout their micro-teaching video creation. There were numerous opportunities for preservice teachers

to enhance those skills as they started creating a storyline of the micro-teaching video, editing, layering the video with different multimedia, and evaluating the video before uploading it on WeVu platform.

Promotion of Reflective Practices

While it was inherent for preservice teachers to reflect on their teaching and learning competencies during the design, implementation of micro-teaching, and the creation of micro-teaching videos, they further nurtured the skills to critically reflect as they provided comments on their peers' micro-teaching sessions. Preservice teachers framed their feedback on peers' micro-teaching using a course-based rubric that emphasized key competencies according to the TPACK's framework. This rubric aligned as well with the goals of facilitating reflection by viewing the process of reflection through the autobiographical (exploring one's own beliefs and practices) lens, peers' experiences (peers' insights and perspectives), and students' eyes (using students' contexts and point of views) [40]. These lenses guided preservice teachers to interrogate their prior and current knowledge vis-à-vis practice and identify future improvements [5] suited for their subsequent blended practicum.

Advancement of Accessibility and Equity in Technology

The use of WeVideo and WeVu in our STEM methods course micro-teaching offered several opportunities for preservice teachers to expand their TPACK, enhance engagement and collaboration among peers as learners and practitioners, and extend access in and equity for STEM learning in either synchronous or asynchronous mode. The collaborative features of WeVideo and WeVu extended the definition of collaborative learning from a traditional perspective (involving interaction within small-group settings) to a contemporary view (involving the whole class and generating collective knowledge to build their community of practice) [32]. Moreover, members of the group that were not available in person in the classroom due to health reasons (e.g., COVID-19 infection), were also able to contribute in the video creation and editing via WeVideo either synchronously or asynchronously. The adoption of WeVideo widened accessibility and equity of STEM methods courses among preservice teachers (who had to attend the course at home due to COVID-19) since it was provided for free, compatible to any device (Chromebook, Windows, Mac, and mobile), and flexible and doable at any stage of the micro-teaching planning and implementation with internal arrangement with their peers.

Creation of Community of Reflective Practitioners

Giving thoughtful feedback on peers' lessons is one of the most powerful ways of improving one's own teaching [41]. This technology-empowered reflection also encouraged preservice teachers to consider how they could deliberately use technology in their own STEM lessons. In addition, this process emphasized the iterative nature of teaching which is so important for future teachers to consider: there are no perfect lessons. Thus, every lesson should be 'Reviewed, Reflected on, Reimagined, Redesigned, and Reevaluated'. And this iterative 5R process is best done with the community of peers which is at the core of the DPTwT framework. This was the main reason why we introduced the peer feedback assignment using CLAS into our methods

courses: we wanted pre-service teachers not only to experience teaching mini-lessons, but also to engage in the 5R process with their peers. This process encourages them to observe carefully, to provide constructive feedback, and to accept peer feedback in a positive way. It also helps them notice what they want to improve and what they want to work on. In other words, the CLAS-supported microteaching encourages preservice teachers to become deliberate in the pedagogical choices they make including choices of technologies or instructional approaches. For example, as a result of this reflection, preservice teachers might decide to re-teach a lesson. This was a very common experience in our STEM methods courses. After watching their own mini-lessons and seeing the feedback from the instructor and their peers, several preservice teachers decided to re-teach their lessons. Since both mini-lessons were recorded and uploaded on CLAS, they could see the difference between their original and improved lessons. It was an empowering learning experience that gave the preservice teachers the much-needed confidence that they can figure things out and if a lesson doesn't go as well as they wanted the first time around, they always have a second chance.

Exploration of Novel Pedagogical Approaches

Learning to remove yourself from your own lessons and to reflect on them in order to teach better in the future is a core quality of a STEM educator in the 21st century. To be successful in the era of fast-changing student population, rapidly evolving technologies, that have unprecedented pedagogical potential, such as ChatGPT [42, 43], continuously changing educational context, and assessment practices, requires educators to be open to novel pedagogical approaches, and new ways of engaging their students [44]. Not all of these approaches will work for us and it will take time to adjust them to fit our learning environments. Thus, accepting our own teaching practice as a work in progress is a critical attribute of an effective teacher. Using CLAS to reflect on their own lessons will allow preservice teachers to view their own teaching struggles as opportunities for learning and personal growth. Having an opportunity to observe recorded lessons allows us to slow down and to see where potential student difficulties might come from. While we recorded mini-lessons where the students were also preservice teachers, nobody (as long as we obey ethical conduct) precludes us from recording and analyzing real lessons. For example, preservice teachers might want to record their own lessons during the practicum and then analyze them at home.

Conclusions and Future Directions

This full paper of computer supported pedagogy presented the use of collaborative technologies as an innovative way of enriching the pedagogies of practicum in ITE program in post-pandemic context. Particularly, we adopted WeVideo, WeVu, and CLAS to reimagine the design, implementation, and assessment of micro-teaching with our preservice teachers in our STEM methods courses in Canadian setting. Our micro-teaching including the learnings we identified was viewed through the lens of DPTwT inspired by TPACK, CoP, and reflective practice frameworks. These learnings include the following:

1) Expanding TPACK of STEM Preservice Teachers

Critical preparations and implementations involved in micro-teaching provided opportunities for the preservice teachers to increase their understanding of STEM concepts, explore pedagogical

strategies to teach those concepts, and maximize the teaching and learning affordances of collaborative technologies (WeVideo, WeVu, and CLAS). Existing research on teaching practicum indicated that preservice teachers have limited TPACK knowledge [45] and such limitation demonstrates the gaps on how preservice teachers integrate technologies in their practicum. Although research shows that teachers' TPACK develops at a more in-depth level during their actual teaching practice (Herring et al., 2016), the engaging process of micro-teaching and the use WeVideo, WeVu, and CLAS illustrated that preservice teachers' TPACK grew.

2) Establishing a Community of STEM Preservice Teachers as Reflective Practitioners

The design and implementation of micro-teaching, and the preservice teachers' thoughtful and constructive feedback on peers' micro-teaching allowed each preservice teacher to actively engage with their peers. Such engagement involves iterative review, reflection, reimagination, redesign, and reevaluation of their collective teaching and learning knowledge and practice. These iterative processes immersed preservice teachers in the co-construction of knowledge and examination of practices [46].

3) Promoting Accessibility and Equity Through Creative Use of Collaborative Technologies

Besides having free access to WeVideo, WeVu, and CLAS, the collaborative nature of these Web-based technologies expanded preservice teachers' participation with their peers. Preservice teachers were able to contribute in most of the stages of preparation in micro-teaching, provide comments on micro-teaching, review the micro-teaching videos, and maintain connection with their peers synchronously or asynchronously whether they were in school, at home or in any locations with Internet connection.

However, as we mentioned in the beginning of this paper and promoted by the Association of Canadian Deans of Education's General Accord, the advances and further use of technologies that foster collaboration and simulation will require a dynamic interplay of educational theory, research, and practice when adopted in educational contexts particularly in ITE program. For example, robust examination is needed to ascertain what aspects of preservice teachers' subsequent teaching practicum had actually been enhanced by the use of collaborative technologies in micro-teaching in their STEM methods courses. This purposive examination will necessitate follow-up longitudinal or case studies with quantitative and qualitative analyses of preservice teachers from their STEM methods courses to their teaching practicum and initial years of their actual teaching. In addition, collaboration with the use of collaborative technology involves complex teaching and learning mechanisms and thus it requires strong grounding in theory and practice. For example, by conducting a micro-teaching in controlled environments using HITL [4], preservice teachers can focus on specific teaching and learning needs which is generally challenging to address and attain in a complex and real-life classroom settings. While such affordances appear to be valuable, the adoption of HITL and other related technologies requires more comprehensive approach and further investigation.

Our full paper described the process of reimagining preservice teacher education through incorporating innovative collaborative technologies, such as WeVideo, WeVu, and CLAS in

STEM methods courses. Our goal was to reimagine future teachers' micro-teaching experiences through grounding them in theory, research, and practice in order to inform the pedagogical approach of future teachers during their consequent practicum in post-pandemic setting. We argue that the use of collaborative technologies in micro-teaching during STEM methods courses in ITE program provided several opportunities for the development of preservice teachers as reflective practitioners way before their long-awaited school practicum, as well as helped them gain valuable experiences, and build confidence in STEM teaching.

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Appendix A: Exit Slip Questions

1. Reflect on the integration of technology in your micro-teaching video. How did the technology enhance the learning experience within your group? Were there any challenges you encountered in using the technology effectively, and how did you address them, individually and as a group?

2. Consider the alignment between your science teaching pedagogy and the instructional strategies employed in your micro-teaching video. How did you ensure that your teaching methods effectively facilitated student understanding of scientific concepts? What adjustments would you make to better integrate pedagogical principles into future lessons?

3. As you watched your peers' micro-teaching videos, identify one innovative use of technology for science instruction. How did this technology support student engagement and learning? How might you adapt or incorporate similar technological tools into your own teaching practice in the future?

4. Reflect on the collaborative process of designing and creating micro-teaching videos within your community of practice. How did working with peers contribute to your understanding of effective science teaching strategies and technology integration? What insights or perspectives did you gain from observing and providing feedback on your peers' videos?

5. Provide constructive feedback on one of your peers' micro-teaching videos, focusing specifically on the integration of technology and science teaching pedagogy. What aspects of their lesson design and delivery effectively utilized technology to enhance student learning? What recommendations do you have for further strengthening the integration of technology and pedagogy in their instructional approach?

Appendix B: WeVu Rubric on Quality Comments

Criteria	Exemplary (3)	Proficient (2)	Basic (1)
Accuracy of Content Understanding	Provides in-depth and accurate feedback on the conceptual knowledge and understanding presented in the micro-teaching video, affirming or addressing any inaccuracies with clear explanations.	Offers well-detailed comments on the accuracy of content, addressing most concepts with clarity and precision.	Provides limited comments on the accuracy of content, with some important concepts overlooked or unclearly addressed.
Identification and Commendation of Best Practices	Identifies and commends specific best practices related to teaching and learning, including creativity, culturally relevant pedagogy, inclusivity, inquiry-based methods, and UDL-centered approaches. Offers detailed praise for effective practices observed.	Recognizes and commends various best practices in teaching and learning, though some comments may lack specificity or depth.	Offers minimal identification and commendation of best practices, with limited details on observed effective teaching methods.
Expansion and Enrichment of Ideas	Expands and enriches the ideas presented in the micro-teaching video, providing insightful suggestions related to content, pedagogy, and technology integration. Builds on colleagues' ideas in a constructive and valuable manner.	Offers constructive suggestions for expanding and enriching the ideas presented, contributing to the overall improvement of the micro-teaching video.	Provides limited suggestions for expansion or enrichment, with minimal impact on the overall enhancement of the colleague's ideas.