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Listening to Teacher Candidates and Teacher Educators: Revising Educational Technology Courses in a Canadian Teacher Education Program

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Abstract: Educational technology courses in teacher education programs are critical as they equip teacher candidates (TCs) with the necessary knowledge, skills, and attitudes to incorporate technology into their teaching. Given the rapid technological advancements, it is essential that these courses implement research-informed and current practices to promote TCs' preparedness in using educational technologies. Accordingly, the instructional team of the educational technology course in the teacher education program at Brock University—Canada initiated a rigorous process to revise this course. This process included exploring the evolving needs of TCs and their feedback on previous course iterations and consulting with teacher educators who lead other courses in the program to ensure curriculum alignment. This paper aims to achieve the following: (1) document the course revision process, with a focus on how TCs and teacher educators were involved; (2) explore TCs' evolving needs in educational technology; (3) present the revised educational technology course. The paper presents the findings of a survey administered to 116 TCs, focus groups with TCs, and a survey administered to 14 teacher educators. Findings from TCs' survey showed high levels of their self-assessment of digital competence and intention to use technology in their future teaching. However, TCs believed that they had not received adequate training to do so, suggesting improvements in the design and delivery of the educational technology course. Drawing on the Voice Theory and instructional design models relevant to educational technology courses, this research offers valuable insights into TCs' digital competence, the scholarship of teaching and learning, and universities' response to change. Implications for teacher education research and practice are also discussed based on the course revisions and the adopted process.

Keywords: educational technology; course design; TPACK; teacher education



Academic Editors: Marta Abelha,
Angélica Monteiro and Filipa Seabra

Received: 23 April 2025

Revised: 7 June 2025

Accepted: 9 June 2025

Published: 11 June 2025

Citation: Estaiteyeh, M., Heenan, J., & Sovegarto, B. (2025). Listening to Teacher Candidates and Teacher Educators: Revising Educational Technology Courses in a Canadian Teacher Education Program. *Education Sciences*, 15(6), 730. <https://doi.org/10.3390/educsci15060730>

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1. Introduction

Technology has the potential to transform learning environments by fostering more interactive, inclusive, and collaborative experiences for students (Estaiteyeh & DeCoito, 2024; Laurillard, 2012). Technological tools can also promote students' creativity and digital literacy skills which are much needed in an increasingly digital world (Recker et al., 2013; Hoffman, 2018). The use of digital resources, such as multimedia, online simulations, and virtual labs, allows for engaging learning opportunities that enhance students' understanding of complex concepts (Çelik & Baturay, 2024). Importantly, recent advancements in emerging technologies such as artificial intelligence (AI) and immersive technologies (such as virtual reality) are amplifying those affordances. For instance, AI-powered tools, such as intelligent tutoring systems and adaptive assessments, can adjust

instructional content in real time, ensuring that students receive customized learning pathways based on their individual learning needs (Fadel et al., 2019). Virtual, augmented, and mixed-reality applications can enhance student engagement by creating interactive, experiential learning environments that simulate real-world scenarios (Radianti et al., 2020).

To attain the desired outcomes of integrating technology in the classroom, K-12 teachers must be able to navigate its opportunities and overcome its challenges (Ertmer et al., 2015). However, research studies highlight that teacher candidates (TCs) are often not adequately prepared to incorporate digital technologies into their teaching (Moorhouse, 2021). The COVID-19 pandemic has also exposed gaps in educators' preparedness, self-efficacy, and comfort level with educational technologies, underscoring the need for enhanced digital competencies in teacher education programming (Barbour & Hodges, 2025; DeCoito & Estaiteyeh, 2022). Notably, educational technology courses in teacher education programs are critical as they equip TCs with the necessary knowledge, skills, and attitudes to effectively integrate technology into their teaching to enhance learning outcomes (Lambert & Gong, 2010). As such, it is essential that these courses incorporate research-informed and current practices to promote TCs' preparedness in using educational technologies (Aleksieva, 2025).

Research Rationale and Objectives

The aforementioned advancements in technology, especially in AI, and the lessons learned from the COVID-19 pandemic necessitate revisiting teacher education courses to foster TCs' digital competence. In harmony, anecdotal evidence from TCs at Brock University—Canada after the pandemic has also implied that they have evolving needs in educational technology that must be addressed in teacher education courses. Accordingly, the instructional team of the educational technology course in the teacher education program at Brock University, led by the first author of this paper, initiated a rigorous process to review and redesign this course.

The course revision process discussed in this research took place during the academic year 2022–2023. It included (1) exploring the needs of TCs and their feedback on previous iterations of the course, (2) consulting with teacher educators who lead other courses in the program (will also be referred to as team leads) to ensure curriculum alignment between the technology course and their courses, and (3) examining effective practices documented in the literature in relation to instructional design and TCs' training in educational technologies. Although course designers and university instructors regularly revise their courses, this research is warranted for several reasons. First, this paper aims to advance the scholarship of teaching and learning by elaborating on the underlying theoretical foundations and the process of revising teacher education courses. Second, the course revision process was unique as it engaged multiple stakeholders (TCs and teacher educators), while attending to theories in curriculum design and research on TCs' digital competence. Finally, there is a need for more research, especially in the Canadian context, on TCs' views toward and future readiness in the use of technology, especially after the pandemic and along with the advent of AI technologies. Given these rationales, this paper addresses the following research objectives:

1. Documenting the educational technology course revision process, with a focus on how TCs and teacher educators were involved, and how relevant theories and research informed this process.
2. Exploring TCs' evolving needs and interests in the field of educational technology.
3. Presenting the educational technology course that resulted from the curriculum review.

2. Literature Review and Theoretical Framework

2.1. Educational Technology Courses

A stand-alone course on educational technology is a dedicated, focused course designed to support TCs with foundational knowledge and skills to integrate technology into their teaching practice (Buss et al., 2015). These courses typically focus on digital literacy, technology tools, pedagogical strategies, and ethical considerations, allowing TCs to gain comprehensive insights into how to effectively use technology in the classroom to enhance teaching and learning (Warr et al., 2023). While stand-alone courses offer in-depth coverage of technology-specific content, an argument can be made that they are limited in fostering the seamless integration of technology within specific subject areas (Polly et al., 2020). These courses may also create a disconnect between technology training and actual classroom teaching, making it harder for TCs to translate what they have learned into practice (Williams, 2017). Therefore, stand-alone courses should be complemented by an infused approach, where technology is embedded across all subject-specific courses in teacher education programs. This approach ensures that TCs develop both the technical proficiency and the ability to apply technology in diverse educational contexts (Cheek et al., 2019). Williamson et al. (2023) present characteristics of technology-infused programs, including (1) pervasive technology content which integrates technology meaningfully throughout coursework and (2) shared responsibility, emphasizing collaboration among faculty and stakeholders in supporting technology infusion. Importantly, Clausen et al. (2023) highlight the pivotal roles of faculty members in advancing technology integration within such a model and point to challenges in infusing technology throughout the curriculum in teacher education programs. Polly et al. (2020) reiterate how modeling by teacher education faculty (teacher educators) influences TCs' development of technology integration skills.

Despite the benefits afforded by the infused approach, eliminating stand-alone educational technology courses may overlook the foundational knowledge and skills necessary for novice teachers to effectively integrate technology in their teaching (Williamson et al., 2023). Buss et al. (2015) indicate that stand-alone educational technology courses can still offer focused instructional time on essential topics that may not be adequately addressed through infusion alone. Buss et al. found that stand-alone courses provide greater exposure and more hands-on experiences with technology, thereby enhancing TCs' proficiency in these areas. Therefore, instead of viewing these approaches as mutually exclusive, combining stand-alone educational technology courses with an infused approach ensures both depth and breadth in TCs' preparation (Wang & Chen, 2006).

2.2. Models Informing the Educational Technology Course Design

To prepare future teachers, designing stand-alone educational technology courses involves aligning its content with research-informed practices and relevant theoretical and conceptual frameworks. These courses must ensure that TCs are not only proficient in using technological tools and resources but also able to integrate these tools effectively into their teaching practices to support student learning needs and outcomes (Mishra & Koehler, 2006). Hence, these courses must encompass content knowledge, pedagogical skills, technological proficiency, assessment techniques, ethical considerations, collaborative strategies, and reflective practices (Warr et al., 2023). The courses should also offer hands-on experience with a variety of educational technologies and provide opportunities for TCs to design and implement technology-enhanced lessons, with a focus on fostering critical thinking, creativity, and collaboration (Polly et al., 2020; Williams, 2017). The section below outlines the major models that informed the redesign of the educational technology course discussed in this paper.

2.2.1. TPACK Framework

The successful integration of digital technologies in teaching depends on teachers' strong course design, appropriate material selection, effective teaching and learning strategies, and clear communication with students and their families alike (Recker et al., 2013; Simonson et al., 2009; Valverde-Berrocoso et al., 2021). The TPACK framework (Technological, Pedagogical, and Content Knowledge), originally developed by Mishra and Koehler (2006), emphasizes this intersection of content knowledge, pedagogical skills, and technological proficiency for effective teaching using technology. It posits that teachers must not only be experts in their subject area (content knowledge) and understand how to teach effectively (pedagogical knowledge) but also be proficient in using technology to enhance learning (technological knowledge) (Chai et al., 2013; Koehler & Mishra, 2009). However, recent re-examinations, critiques, and revisions of the TPACK model suggest that the original framework no longer fully captures the complexity of teaching in this time of emerging technologies, including Generative AI (Mishra et al., 2023). For instance, Thyssen et al. (2023) introduce the DPACK model, which extends TPACK by incorporating digital and sociocultural dimensions which are now considered essential in technology-integrated learning environments. Most recently, Petko et al. (2025) propose a contextualized update to TPACK, offering a more flexible model that accounts for various contexts that teachers encounter.

These theoretical developments are essential in understanding how TCs can be supported in developing meaningful and context-aware technology integration skills within classroom settings. As such, TCs' training plays a significant role in promoting their technology self-efficacy (Joshi, 2023) and enhancing their TPACK levels as they connect their content areas, content-specific pedagogies, and available technologies (Estaiteyeh et al., 2024). Acknowledging the role of stand-alone educational technology courses, this paper focuses on the need for and the ways to revise these courses to ensure optimal outcomes in relation to developing TCs' TPACK in a way that reflects the dynamic nature of digital teaching and learning in today's classrooms.

2.2.2. Backward Design Model

Backward design is an instructional framework that begins with identifying desired learning outcomes and then works backward to develop effective instructional activities and assessment practices that align with those goals (Jensen et al., 2017). It is a systematic approach to curriculum development, emphasizing the alignment of learning objectives with assessments and instructional strategies (Wiggins & McTighe, 1998). This approach ensures that teaching is purposefully directed toward achieving specific educational objectives (Jensen et al., 2017). Research has shown that implementing backward design can significantly enhance students' understanding and engagement by providing meaningful contexts for learning (Ontaneda & Sánchez Román, 2019). By adopting backward design, educators can create more focused and impactful instructional plans that promote deeper understanding and engagement among students (Kerimoğlu & Altun, 2024). With the overarching objective of developing TCs' TPACK levels and inspired by the International Society for Technology in Education Standards for Educators (ISTE, 2024) as specific outcomes, the backward design model was adopted to revise the contents of the stand-alone educational technology course explored in this paper.

2.2.3. Voice Theory

Drawing on student-centered learning principles (Dewey, 1916), Rudduck and Fielding (2006) conceptualized the Voice Theory highlighting the importance of involving students in curriculum design. Rudduck and Fielding emphasize fostering environments

where students' voices are actively heard and valued. The Voice Theory encourages a democratic approach to education by recognizing students as active agents in their learning, not passive recipients of instruction. This theory advocates for empowering students to share their views and contribute to decisions that affect their learning environments. Hearing students' voices can lead to more meaningful learning experiences and increased motivation, as students feel that their perspectives are respected and integral to the learning process (Rudduck & Fielding, 2006). This theory has informed the educational technology course revisions as TCs were engaged using surveys and focus groups to elicit their feedback on the previous iterations of the course, explore their evolving needs, and note their recommendations.

2.2.4. Additional Considerations

According to Warr et al. (2023), the design of educational technology courses in teacher education is often consistent with seven key criteria: alignment with standards, integration of theory and practice, scaffolded learning, active learning, assessment and feedback, flexibility, and collaborative opportunities. These criteria ensure that TCs are prepared for the challenges and opportunities of teaching with technology. In harmony, Figg and Jaipal-Jamani (2020) summarize important considerations for effective technology-enhanced learning experiences in teacher education. These considerations also informed the course revisions, including the following:

1. Modeling technology-enhanced learning experiences in the context of subject content areas.
2. Engaging TCs in pedagogical reasoning during the technology-enabled learning experience to ensure that they understand how to teach with technologies.
3. Addressing competency in all TPACK domains, by including connections to content subject areas through examples of technology-enhanced activities.
4. Collaborative/peer learning and authentic technology-enhanced learning experiences.
5. Providing opportunities for TCs to design and teach technology-enhanced lessons.
6. Incorporating multiple forms of assessments to measure TCs' development of TPACK knowledge and competence.

Overall, this research presents a unique approach in revising educational technology courses in response to current technological advances and TCs' evolving needs. Concurrently, this research incorporates curriculum development theories, instructional design models, and research-informed practices aimed at promoting TCs' TPACK. This dynamic combination of theory and practice promises to advance the scholarship of teaching and learning in the context of educational technology courses.

3. Methodology

A mixed methods case-study approach was adopted (Creswell & Creswell, 2018). Both quantitative and qualitative data were collected using: (1) end-of-year survey administered to Year 1 and Year 2 TCs; (2) focus groups with TCs in Year 1 of the program right after the completion of the educational technology course; and (3) survey administered to teacher educators. Ethical clearance was granted by the Research Ethics Board at Brock University to conduct this research.

3.1. Research Setting and Participants

The setting for this case study is the teacher education program at Brock University in Ontario, Canada. The teacher education program in Ontario is a two-year program. At this university, TCs are enrolled in one of three divisions: Primary-Junior (P/J), Junior-Intermediate (J/I), and Intermediate-Senior (I/S). Brock University offers one stand-alone

course on educational technologies in each division: one for the P/J/I division (combined Primary-Junior-Intermediate) and another for the I/S division (Intermediate-Senior). Upon program completion, TCs in the P/J/I division are certified to teach as homeroom teachers (all subjects) in elementary and/or intermediate classes. TCs in the I/S division are certified to teach two subjects in intermediate and secondary classes. Typical combinations of I/S subjects are science and biology, physics/chemistry and math, English language and history, etc.

In this study, a total of 116 TCs participated in the student survey: 37 TCs in Year 1 of the teacher education program (18 P/J/I division and 19 I/S division) and 79 TCs in Year 2 of the program (55 P/J/I and 24 I/S). Additionally, 14 teacher educators participated in the faculty survey. Those teacher educators are team leads who oversee subject-specific courses in the teacher education program (such as literacy, sciences, etc.).

3.2. Data Sources

Between April and May 2023, mass recruitment emails were sent to all TCs in the teacher education program at the university. Consenting TCs completed an online survey (through Qualtrics XM survey software (<https://www.qualtrics.com/>)). The survey included 12 five-point Likert scale statements and four open-ended questions. The survey explored TCs' needs, digital competence, and feedback on previous iterations of the course. Survey Likert scale statements were informed by DeCoito and Estaiteyeh's (2022) survey and were tested for content validity by two experts in the field. The open-ended questions were developed by the first author based on the research questions and the literature. Sample questions included:

- What have your experiences been with the Ed Tech course you took in Year 1? To what extent was this course helpful in teaching you specific pedagogical and technological concepts or skills to use technology in your teaching?
- List some skills or concepts, offered in the teacher education program, that you found helpful in preparing you as a teacher to use educational technologies effectively in the future.
- List some skills or concepts that you feel you still lack as a teacher, to be able to use educational technologies effectively in the future.

Additionally, 30-minute focus groups were held with six groups of TCs in Year 1 of the program right after the completion of the course to obtain their detailed insights and suggestions. Focus group questions included:

- List and discuss 3–5 new concepts you learned or new skills you acquired in this course that would impact your future teaching.
- List and discuss 3–5 things you would like to see changed in this course (topic change, course modality, anything, etc.).
- Recommend 5 additional topics, concepts, and/or skills to add to future iterations of this course.

Furthermore, consultations with other teacher educators through the survey aimed at ensuring curriculum alignment between the revised course and their courses. The survey included one Likert scale item and four open-ended questions. The Likert scale item asked faculty members to rate TCs' digital competence. Sample open-ended questions included:

- What are various educational technology tools, skills, or concepts that teacher candidates in your courses engage in or learn about?
- What are other educational technology tools, skills, or concepts that you would like teacher candidates in your courses to learn about, but you can't offer due to time constraints or lack of resources?

3.3. Data Analysis

Quantitative data from surveys were analyzed using Microsoft Excel. Descriptive statistics were performed including calculating averages, standard deviations, and percentages. Moreover, to obtain deeper insights into the quantitative results, two inferential statistical tests were performed using IBM SPSS 30. To highlight if the differences between Year 1 and Year 2 TCs' responses are statistically significant, the Mann-Whitney U test was performed as it is the non-parametric test used to compare two ordinal variables (Likert scale statements). Also, to analyze correlations between TCs' responses on various Likert scale statements, Spearman's rank-order correlation test was performed, since the data are related to ordinal variables and are not normally distributed (Connolly, 2007).

As for the qualitative data from the open-ended survey questions and focus groups, the authors used manual coding following an inductive process to develop, interpret, and finalize themes to draw conclusions (Gall et al., 2005). The analysis was conducted by the second and third authors independently. Then, meetings were held with the first author to discuss, unify, and finalize the coding and ensure the trustworthiness of the analysis.

4. Results

4.1. TCs' Competence in and Views Toward Using Technology

Table 1 presents Year 1 and Year 2 TCs' rating of their competence in and views toward using educational technologies, with an average close to 4 indicating agreement and close to 3 indicating neither agree nor disagree. The standard deviation value is also included to show the degree of variation in TCs' responses. Participants who had just completed their first year of the teacher education program are herein referred to as Year 1 TCs, and those who had just finished their second year of the program are referred to as Year 2 TCs.

Table 1. TCs' average agreement with statements related to their competence in and views toward using technology.

Statement	Year 1	Year 2
I rate my competency using technology as high.	4.27 (0.89)	4.14 (0.87)
I rate my competency using educational technologies as high.	3.95 (0.77)	3.92 (0.79)
By now, I have enough resources to use technology in my future teaching.	4.00 (0.96)	3.85 (0.83)
By now, I have received adequate training to use technology in my future teaching.	3.84 (0.75)	3.38 (1.00)
I am confident and ready to use educational technologies in my future teaching.	4.03 (0.85)	3.84 (0.83)
I am likely to use technology extensively in my future teaching.	4.19 (0.86)	4.05 (0.96)

1 = Strongly disagree, 5 = strongly agree, standard deviation shown between parentheses.

Firstly, the highest rated response for both Year 1 and Year 2 TCs was on rating their general technology competency with an average of 4.27 for Year 1 and 4.14 for Year 2. Notably, TCs rated their competency using educational technologies specifically slightly lower with an average of 3.95 for Year 1 and 3.92 for Year 2. Second, when responding to the question of having enough resources to use technology in their future teaching, both Year 1 and Year 2 TCs generally agreed that they had access to resources. However, the average agreement level is notably lower on the statement related to receiving adequate training to use technology in their future teaching, with Year 1 TCs averaging 3.84 and Year 2 TCs averaging 3.38, indicating less agreement with their preparation for digital classrooms. Furthermore, in examining TC's perceived confidence and readiness to use

educational technology, Year 1 TCs showed slightly higher agreement compared to Year 2, with both numbers close to 4 indicating agreement. Finally, in response to whether TCs felt likely to use technology extensively in their future teaching, both Year 1 ($M = 4.19$) and Year 2 ($M = 4.05$) indicated a strong intention to use technology.

Overall, the average responses for Year 1 and Year 2 TCs were relatively similar. This finding was confirmed by the results of the inferential statistical tests. A series of Mann-Whitney U tests was conducted to compare Year 1 and Year 2 responses across the six statements presented in Table 1. Results indicated that there were no statistically significant differences in mean scores between the two years for any of the statements. These findings suggest that TCs' views were consistent across both cohorts.

Interestingly, despite TCs thinking that they had not received adequate training to use technology, they still expressed confidence, readiness, and intention to use technology in their future teaching. A series of Spearman's rank-order correlations was conducted to assess the relationships between selected survey statements. The results indicated that there was a strong, positive correlation between the following statements:

- TCs' rating of their competency using technology as high and their confidence/readiness to use educational technologies in their future teaching.
- TCs' rating of their competency using technology as high and the likeliness to use technology extensively in their future teaching.
- TCs' rating of their competency using educational technology as high and their confidence/readiness to use educational technologies in their future teaching.
- TCs' rating of their competency using educational technology as high and the likeliness to use technology extensively in their future teaching.
- TCs' receiving adequate training to use technology in their future teaching and the likeliness to use technology extensively in their future teaching.
- TCs' receiving adequate training to use technology in their future teaching and their confidence/readiness to use educational technologies in their future teaching.
- TCs' confidence/readiness to use educational technologies in their future teaching and the likeliness to use technology extensively in their future teaching.

4.2. TCs' Satisfaction with Their Preparation to Use Technology

To further explore TCs' satisfaction with various approaches aimed at preparing them to use technology, TCs were asked to rate the value or the benefit of these approaches. Table 2 presents Year 1 and Year 2 TCs' ratings, with averages higher than 3.5 indicating an overall satisfaction and less than 3.5 indicating relative unsatisfaction. To consolidate the results, data for Year 1 and Year 2 TCs were combined as shown in Figure 1, especially in that they showed similar ratings on most statements as evident in Table 2. Also, to simplify the findings further, the 5-point Likert scale is now presented as a 3-point Likert scale in Figure 1, with 3 being highly effective, 2 being moderately effective, and 1 being not as effective.

Table 2. TCs' average rating of their satisfaction with offerings aimed at their preparation to use technology.

Statement	Year 1	Year 2
The Ed Tech course in Year 1	2.95 (1.27)	2.90 (1.33)
Other courses in Year 1 or Year 2	3.11 (0.89)	2.87 (0.98)
Learning from peers	3.86 (0.78)	3.91 (0.93)
Practicum Experiences	3.94 (1.10)	3.96 (1.06)
Training opportunities at the university	2.81 (0.90)	2.49 (1.03)
Training opportunities outside of the university	2.71 (0.97)	2.74 (1.04)

1 = Not effective, 5 = highly effective, standard deviation shown between parentheses.

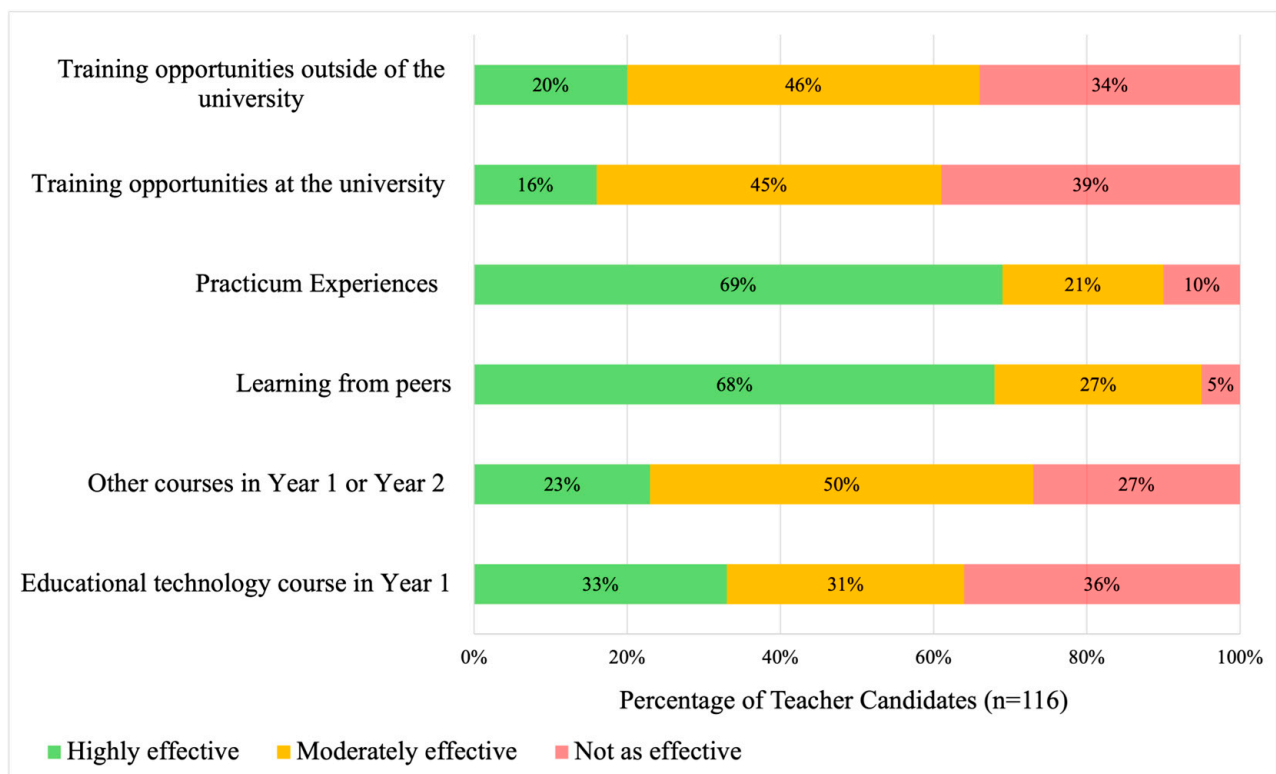


Figure 1. Percentage of TCs (Year 1 and Year 2 combined) indicating the effectiveness of various program components in preparing them to teach using technology.

As shown in Table 2 and Figure 1, TCs were most satisfied with their practicum experiences and learning from their peers through class discussions and sharing resources. The averages on both statements approached 4 out of 5 indicating effectiveness. Also, the majority of TCs (almost 70% on both statements) indicated that the practicum and their peers were highly effective in preparing them to use technology. These results suggest that practicum experiences were a highly valued and meaningful part of the teacher education program and that peer learning was among the most significant experiences throughout this program.

On average, TCs rated the educational technology course as moderately effective in both Year 1 ($M = 2.95$) and Year 2 ($M = 2.90$). The average scores for both cohorts were similar, suggesting consistent perceptions of the course's effectiveness over time. When looking at the combined scores of Year 1 and Year 2 TCs, TCs' rating was equally divided with each one-third of participants finding the course to be highly effective, moderately effective, and not as effective. Similarly, TCs rated the integration of educational technology concepts in other courses in the program as moderately effective, with an average of 3.11 in Year 1 and 2.87 in Year 2. This suggests that the integration of educational technology can be strengthened throughout the program.

On the other hand, the findings show that TCs were least satisfied with training/professional development on educational technology at and outside of the university with only 16% and 20% of TCs respectively finding those opportunities as highly effective. These training sessions are typically arranged by the teacher education program through guest speakers and faculty members or held independently through teacher associations, non-governmental organizations, other universities, school boards, or technological companies (to name a few). This unsatisfaction indicates a growing need to enhance the visibility, accessibility, or perceived relevance of these opportunities to support TCs' development.

It is also important to note that the results of Mann–Whitney U tests also indicated that there were no statistically significant differences in mean scores between the two years for any of the six statements presented in Table 2. These findings suggest that TCs' views on their preparation in educational technology were consistent across both cohorts.

4.3. TCs' Experiences in the Educational Technology Course

The quantitative data presented earlier was supported by TCs' responses to three open-ended questions. First, to elicit their feedback on the offered stand-alone educational technology course, TCs were asked about their experiences in this course and whether/how it was helpful to teach them specific pedagogical and technological skills to use technology in their teaching. In examining this question, 21 TCs believed this course was helpful, 20 believed it was not helpful, and 17 felt it was somewhat helpful. Among those who thought the course was helpful or somewhat helpful, two themes emerged to describe the benefits: (1) learning new concepts and skills, and (2) improving their views and attitudes toward technology.

On learning new concepts, TCs said the course exposed them to a wide range of digital tools and platforms they could integrate into their classroom practice. They appreciated gaining hands-on experiences with applications like Google Classroom, Forms, Slides, and Sites. These TCs found it beneficial to have the opportunity to try out the educational technologies covered in the course before using them in their teaching. Engaging directly with the tools built their confidence and allowed them to consider how these platforms could support classroom organization, communication, and student engagement. TCs said:

I learned a lot of tech skills during {this} class! I learned important tricks and strategies for using tech as a teacher that I have definitely already used in school and in my placements—things like how to create slide shows, websites, polls, videos, and a range of multimedia. (TC22, Year 2)

My experience in {this course} taught me a lot about the different things you can do on Google-based platforms such as Google Keep, Google Form, building Google classrooms, etc! (TC45, Year 2)

On improving attitudes, TCs shared that their attitude toward technology was improved in this course. Those TCs discussed how the course helped them feel more comfortable or confident using educational technologies. For example, one TC shared:

This course is primarily why I feel confident in my ability to incorporate technology in future classrooms. (TC50, Year 2)

{This course} did make me more confident, but I wish there was more work and support on various tools that are applicable to the classroom. . . as these applications are constantly changing. (TC47, Year 2)

On the other hand, TCs who did not feel this course was helpful shared issues with its content, assignments, and associated workload. TCs most often referenced the need for more practical tools to be covered in the course. For example:

This course only looked at the most basic easy to use resources. Things like google docs and google slides. These are all resources that most people with ANY understanding of technology can use effectively. (TC87, Year 1)

TCs who found the course content not as helpful cited their high prior digital literacy levels as the basis for this belief. This reflection shows that TCs have evolving needs and interests in the field of educational technology, are aware of the complexity of using technology for educational purposes, and have higher expectations from these courses.

I already use many different google products like drive and slides and did not need to take a class to teach something I have been using for nearly 10 years now. I did not find this course helpful as I already knew how to create google sites and embed videos/slideshows. (TC91, Year 1)

The course could have been longer and gone more in depth of different methods of technology/apps. (TC46, Year 2)

Moreover, a desire for more relevant assignments emerged as a recurring theme. This was generally connected to assignments feeling too time-consuming or disconnected from classroom experiences.

I think that the Genius Hour project is a good idea in theory, but in reality it took up much more time doing something that wasn't very important. If 3 weeks were focused on a specific technology, and the other weeks were facilitations or opportunities to use those technologies, I feel like that would be more useful because we get to see them in action both as teachers and students. (TC25, Year 2)

{This course} needs to provide more practical examples of how we can apply the tech tools in the classroom, it would be great to have some examples provided of actual tech that has been successfully implemented in the class or an example of an assignment that could be done with a tech tool such as the blog or google sites. (TC82, Year 1)

The second open-ended question asked TCs to list some skills or concepts, offered in the teacher education program, that they found helpful in preparing them to use educational technologies effectively. Most significantly, TCs felt as though they learned new technological concepts and skills. TCs also emphasized that gathering resources was very useful for their placements and future careers. Another emerging theme was that TCs stated that practicing using tools and software was helpful in learning technological concepts or skills such as content creation. For example, TCs stated:

I found that the skills I developed in this course relating to perseverance with technology were the most helpful in preparing me as a teacher. I now know how to work Google Sites, and when things were frustrating me or not working how I wanted them to, I kept going because I needed to get them done. I also found that the amount of resources given were helpful just knowing that they are out there as an option. (TC25, Year 2)

One piece I took from the course was being aware of having an online presence... I would never have considered using social media to stay informed on trends emerging in education until this course. (TC108, Year 2)

Moreover, TCs highlighted that opportunities to share resources and collaborate with peers were very helpful. This collaborative approach to learning is significant in a technology course where TCs likely have various levels of competence and comfort levels with digital technologies. By engaging in discussions, sharing resources, and troubleshooting challenges together, TCs can develop a deeper understanding of digital tools while also fostering a supportive learning community.

Finally, the third open-ended question asked TCs about skills or concepts that they feel lacking, so that they can use educational technologies effectively in the future. Some TCs pointed to some technologies that specific school boards use such as learning management systems or grading applications—while acknowledging that different boards adopt different digital tools and platforms:

Learning more about Brightspace as schools are moving towards that learning system. This skill will be important so new teachers can navigate the system as they enter a job. (TC84, Year 1)

Furthermore, TCs expressed that they require more practice with specific software and hardware to promote their readiness for future teaching:

Opportunities to try different tech devices: smart board, smart tv, projector etc to be familiar with how to operate them. (TC93, Year 1)

I just need more practice with specific {technologies} that would be helpful instead of a little bit of knowledge about a lot. (TC25, Year 2)

Importantly, several TCs highlighted issues related to equitable access to technology in schools, which is a challenge that may hinder their ability to implement what they learn in the teacher education program. TCs said:

During placement, technology is not readily accessible so it is nice to learn how to integrate tech but I found I never had an opportunity to use it in placement. To improve, perhaps having the opportunity to use tech in low tech schools would be more beneficial in the teaching program. (TC27, Year 2)

Very few classroom/school boards have access to the type of or speed of tech needed to practice anything we learned. (TC79, Year 1)

4.4. Teacher Educators' Feedback

Teacher Educators' rating of TCs' competence in educational technology was similar to TCs' personal reflections, with seven of 14 considering TCs as somewhat competent and one considering them as highly competent. Other teacher educators considered TCs' competence as average or below. Additionally, teacher educators explained what kinds of technology tools they personally incorporate in their teaching and train TCs on using. Most teacher educators mentioned fundamental web-based applications used for presentations, student collaboration, or polling. Some faculty members mentioned subject-specific technologies such as sensors in sciences, and graphing software and coding in mathematics.

However, teacher educators mentioned time constraints and compact curriculum as challenges to incorporate more technology in their subject-specific courses. Several educators emphasized the need to provide TCs with foundational and pedagogical skills on how to incorporate technology in their future teaching. For instance, teacher educators stated:

I'd like the idea of constructivist use of technology to be reinforced because many of our TCs are designing beautiful slideshows and using it to accompany their teaching and they think it's good teaching. I'd also like them to learn more about how to collect data through web-based applications that can act as diagnostic and formative assessment. (Educator 11)

I'm interested in building TC's and their students' communicative competencies. I'm interested in flexibility and creativity. I think if there is a way to think of the building blocks of ed tech engagement (what are the things they can learn to do or try) that lead to engagement inside and outside of schools? (Educator 3)

Additionally, a few teacher educators emphasized the importance of including emerging technologies in the educational technology course such as AI (Educators 6 and 10), coding (Educator 13), and 3D modeling and printing (Educator 10) because they do not have enough time to cover these topics in their courses despite their importance.

4.5. The Revised Educational Technology Course

Following all these consultations, the team lead of the educational technology course (first author) held several meetings with the instructional team of the course. The lead

shared a new vision for the course and initiated a collaborative curriculum revision process based on TCs' feedback and suggestions, teacher educators' suggestions, and the technology course team input. As a result, a new curriculum has been implemented in the educational technology course at the university. Table A1 in Appendix A presents an overview of the revised course. Further, to complement the content of this 12-week course, an extracurricular program was developed. In this supplementary program, TCs choose to attend professional development sessions in the following topics as relevant to their interests and teaching subjects: micro:bits, coding, and educational robotics; 3D modeling and printing; instructional use of smart boards; and immersive learning experiences through virtual reality and augmented reality.

5. Discussion and Conclusions

Findings from TCs' survey showed high levels of self-assessments of their digital competence. TCs expressed confidence, readiness, and intention to use technology in their future teaching. The positive correlation between TCs' attitudes toward technology and their intention to use it reiterates prior research indicating the strong impact of teachers' attitudes on technology acceptance and thereby actual use (Teo & Milutinović, 2015).

However, TCs believed that they had not received adequate training and rated the educational technology course as moderately effective in preparing them to use technology in their teaching. This finding highlights the rapidly evolving nature of TCs' professional learning needs and interests in response to technological advancements. TCs also cited their high digital literacy levels as the basis for their interest in advanced topics in the educational technology course. This result is expected given that TCs are mostly digital natives who have higher digital competence (Milutinović, 2022) and thereby higher expectations from educational technology courses. On the other hand, TCs emphasized the effectiveness of practicum experiences and peer learning in influencing their use of technology. This finding reiterates the value of practice teaching (school placements/practicum) as a professional experience that contributes to the integration of theory and practice in pre-service teacher education (Hall et al., 2018).

Overall, given TCs' generally positive attitudes toward technology and their enthusiasm for integrating it into their teaching, further efforts are required to ensure they develop the necessary knowledge and skills to enhance their TPACK. Strengthening their proficiency in using technology effectively will empower them to create engaging, innovative, and pedagogically sound learning experiences for their students (Estaiteyeh et al., 2024). These findings suggest that improvements in the design and delivery of TCs' preparation could benefit their engagement with educational technologies throughout and beyond the teacher education program.

Moreover, TCs highlighted that the educational technology course provided new content and skills and improved their attitude toward technology. However, they wanted to learn more practical tools, as well as more challenging and advanced topics given their technological competence. TCs suggested more practice with specific software/hardware along with more resources to use in the future. These reflections, alongside insights from teacher educators, reinforce the notion that stand-alone educational technology courses in teacher education remain valuable and must continuously evolve to provide high-quality, ongoing professional development to TCs (Buss et al., 2015). Furthermore, the rapid evolution of educational technologies and differing policies across school boards necessitate a focus on developing adaptable digital literacy skills and pedagogical strategies, enabling TCs to navigate and implement new technologies effectively. As such, it is important that educational technology courses model TPACK by engaging TCs in pedagogical reasoning during the technology-enabled learning experiences to ensure that they understand how to

teach with technologies rather than merely using various technologies (Estaiteyeh et al., 2024; Figg & Jaipal-Jamani, 2020).

Furthermore, in accordance with the Voice Theory (Rudduck & Fielding, 2006), soliciting TCs' feedback was essential in understanding their unique needs and incorporating their suggestions in the revised course. For instance, the revised course included tools beyond Google products to ensure that TCs are aware of a wide array of technologies that can support their teaching, such as virtual resources, multimedia, digital assessments, and AI. Exposing TCs to a variety of tools promotes their familiarity with different technologies, which promotes their technological self-efficacy and encourages them to explore new tools with minimal hesitation in the future. Moreover, specific suggestions such as online teaching and learning management systems were included in the course content as shown in Table A1. As a requirement in the revised course, TCs create online learning modules using a learning management system that is widely adopted by several Ontario school boards. This project provides TCs with an opportunity to learn about online teaching and learning management systems at the same time. Additional topics were included in the developed extracurricular program to support the course content which could not accommodate all TCs' suggestions. It is also important to note that TCs' feedback influenced the pedagogies adopted in the revised course. For example, TCs asked for more relevance and practicality in the course assignments. Accordingly, the instructional team adopted e-portfolios as a platform for TCs to learn the course concepts and showcase their learning on an ongoing basis. In both assignments, the e-portfolio and the online module, TCs curate and create a repertoire of digital resources that will be very helpful in their future teaching. Thus, by actively engaging with TCs' perspectives, teacher educators can provide targeted support, ensuring they develop confidence and competence in using technology. This responsive approach prepares TCs for the future classroom and empowers them to create innovative learning experiences for their students.

Finally, collaborating with teacher educators/other team leads was insightful as they emphasized the need to provide TCs foundational and pedagogical skills on how to incorporate technology in their future teaching. This suggestion was taken into consideration by the instructional team, as the revised course included links to concepts and theories such as digital literacy and TPACK. The course also engaged TCs in pedagogical reasoning upon using digital tools relevant to specific subjects. Also, teacher educators emphasized the importance of including emerging technologies such as AI in the educational technology course, as they do not have enough time to cover these topics in their courses. As such, AI has been included in the revised course content whereby TCs explore AI applications and engage in critical discussions about its implications (Estaiteyeh & McQuirter, 2024). Overall, teacher educators' involvement highlighted the importance of an infused approach in technology integration that supports and complements stand-alone courses in teacher education programs (Williamson et al., 2023). This collaborative approach also helped minimize the resistance to change that typically accompanies curriculum reform initiatives. Engaging multiple stakeholders was pivotal to incorporating diverse perspectives and amplifying collective efforts.

6. Significance and Implications

This research contributes to the advancement of knowledge in the fields of teacher education and educational technology. It informs teacher education researchers, instructors, and leaders about new directions in these fields and how to better prepare future educators for a technology-enhanced classroom. This is of particular importance given the developments in emerging technologies and after years of emergency online teaching which witnessed an amplified use of educational technologies. Moreover, this research

presents a collaborative course (re)design model that incorporates theoretical foundations, research-informed practices, and insights from multiple stakeholders, thereby contributing to the scholarship of teaching and learning in teacher education.

Current research is ongoing to explore the longitudinal impact of this course on TCs’ digital competence and to inform future course revisions. Future research can explore these subsequent revisions, due to the evolving nature of the field and as a result to any changes at the level of the teacher education program necessitating pedagogical adaptations. Research can also explore the instructional team’s experiences throughout the course revision process highlighting successes and challenges pertaining to change acceptance/ resistance.

Author Contributions: Conceptualization, M.E.; methodology, M.E.; data curation and analysis, M.E., J.H. and B.S.; writing—original draft preparation, M.E., J.H. and B.S.; writing—review and editing, M.E.; supervision, M.E.; project administration, M.E.; funding acquisition, M.E. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Brock University: Centre for Pedagogical Innovation, Chancellor’s Chair for Teaching Excellence Grant.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Brock University (File Number 23-015, on 29 August 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author in accordance with ethics approval guidelines.

Acknowledgments: The first author would like to thank the instructional team of the educational technology course, the participating teacher candidates, the participating teacher educators, and Brock University’s Centre for Pedagogical Innovation.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

- TC Teacher candidate
- TPACK Technological, pedagogical, and content knowledge
- AI Artificial intelligence

Appendix A

Table A1. Overview of the revised educational technology course.

Course Calendar Description
The purpose of this course is to prepare teacher candidates for a technology-enhanced classroom. The course will focus on research-based strategies and concrete suggestions for effective integration of information and communication technologies (ICT) across the curriculum in a way that enhances learning, with special emphasis on topics, strands, and expectations detailed by the Ontario Ministry of Education curriculum documents. In addition, the course will identify the knowledge and skills teachers need to competently teach with technology while providing opportunities for enhancing personal skills with technology tools currently being used in the Ontario classrooms.

Table A1. Cont.

Course Learning Outcomes
In this course, teacher candidates will: • Establish a professional identity and begin using digital tools that will build a positive digital footprint. • Consider the ethical and responsible use of ICT in education, including issues of digital citizenship and online safety. • Articulate an understanding of concepts, theories, and frameworks that support quality lesson design and implementation such as digital literacy and technological, pedagogical, and content knowledge (TPACK) (Koehler & Mishra, 2009). • Develop an understanding of the role, benefits, and challenges of ICT in education and the ways in which it can support teaching and learning. • Gain practical skills in selecting, evaluating, and using a range of educational technologies, including multimedia tools and online resources. • Develop a repertoire of technology-enhanced activities that can be adapted for lessons across the Ontario Curriculum, based on instructional design principles, as well as the technology standards set out by ISTE (2024).
Course Topics
• Introduction to educational technology. • TPACK. • Digital literacy. • Digital design: Principles and practices. • Digital Content Creation: Creating Infographics and instructional videos. • Educational technology tools and applications: The pedagogical principles of using multimedia (videos, animations, podcasts, blogs, memes, GIFs, etc.) and other digital resources (online simulations, virtual labs/museums/field trips, digital timelines, immersive experiences, etc.) for teaching and learning. • Digital assessment tools. • Artificial Intelligence tools: Applications for content creation and development of teaching materials, pedagogical implications, affordances, and limitations. • Creating and maintaining an e-portfolio. • Online teaching and instructional design. • Developing an online module using a learning management system (LMS).

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