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An Environmental Scan of Educational Technology Courses in Ontario Teacher Education Programs

Analyse de l'environnement des cours sur les technologies éducatives dans les programmes de formation des personnes enseignantes en Ontario

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Abstract

In light of lessons learned from online teaching during the pandemic in 2020 and the rapid advancement of educational technologies, greater attention has been directed toward how teachers are being prepared for future classrooms. In teacher education programs, two main models exist to promote the digital competence of teacher candidates (TCs): (a) specialized, stand-alone courses on educational technology, and (b) an infused model in which digital skills are integrated into other courses. We conducted an environmental scan of educational technology courses in teacher education programs across Ontario between April and August of 2024 to explore the models adopted for preparing TCs. The findings show that 14 out of 16 Primary/Junior programs, 9 out of 12 Junior/Intermediate programs, and 9 out of 15 Intermediate/Senior programs, offer stand-alone courses on educational technology, most of which are mandatory. This reliance on stand-alone courses demonstrates an attention to technology training for TCs. However, a potential limitation lies in that most programs rely on only one course. To obtain detailed insights, we also conducted a thematic analysis of the course descriptions, highlighting areas of strength and those needing improvement. This study informs teacher education programs and researchers on future opportunities to develop TCs' digital competence.

Keywords: educational technology, stand-alone courses, teacher education, technology infusion

Résumé

À la lumière des enseignements tirés de l'enseignement en ligne pendant la pandémie de 2020 et des avancées rapides des technologies éducatives, une attention accrue a été accordée à la manière dont les personnes enseignantes sont préparées aux classes de demain. Dans les programmes de formation des personnes enseignantes, deux modèles principaux existent pour promouvoir les compétences numériques des personnes étudiantes en formation à l'enseignement : (a) des cours spécialisés et

indépendants sur les technologies éducatives, et (b) un modèle intégré dans lequel les compétences numériques sont intégrées à d'autres cours. Nous avons procédé à une analyse de l'environnement des cours de technologie éducative dispensés dans les programmes de formation des personnes enseignantes en Ontario entre avril et août 2024 afin d'examiner les modèles adoptés pour la préparation des personnes étudiantes en formation à l'enseignement. Les résultats montrent que 14 des 16 programmes *Primary/Junior*, 9 des 12 programmes *Junior/Intermediate* et 9 des 15 programmes *Intermediate/Senior* proposent des cours indépendantes sur les technologies éducatives, dont la plupart sont obligatoires. Ce recours à des cours indépendants témoigne de l'importance accordée à la formation technologique des personnes étudiantes en formation à l'enseignement. Cependant, le fait que la plupart des programmes ne proposent qu'un seul cours constitue une limite potentielle. Afin d'obtenir des informations détaillées, nous avons également procédé à une analyse thématique des descriptions des cours, mettant en évidence les points forts et les domaines à améliorer. Cette étude informe les programmes de formation à l'enseignement et les personnes chercheuses sur les possibilités futures de développer les compétences numériques des personnes étudiantes en formation à l'enseignement.

Mots-clés : cours spécialisés, formation des personnes enseignantes, intégration de la technologie, technologie éducative

Introduction

Incorporating technology in teaching involves understanding the tools and applying them strategically to enhance educational practices (Steel & Hudson, 2001). For preservice teachers, integrating technology effectively begins with training in teacher education programs (Mishra & Koehler, 2006). Thus, it is crucial to explore how teacher candidates (TCs) are being prepared to use technology in their future classrooms. This question has become more pressing following the transition to online teaching during the COVID-19 pandemic, which revealed shortcomings in our educational systems, especially in terms of technology-enhanced teaching (DeCoito & Estaiteyeh, 2022a, 2022b). The recent advancements in educational technologies including the use of artificial intelligence (AI) tools in education have also fueled those discussions. Accordingly, this research aimed to identify how educational technology concepts were integrated into teacher education programs in Ontario, Canada, by addressing the following research questions:

1. What model(s) do teacher education programs in Ontario predominantly adopt in preparing TCs in educational technologies (stand-alone courses versus infused approaches)?
2. What do stand-alone educational technology course descriptions reveal about the intended scope and focus of these courses?

To answer the research questions, we conducted a comprehensive environmental scan and content analysis of course offerings on educational technology in preservice teacher education programs in Ontario. The findings highlight strengths, areas for improvement, and future research directions on promoting TCs' digital competence in teacher education.

Literature Review

Digital Competence and TPACK

Digital competence, an important 21st century skill, refers to the numerous abilities required to navigate a digital society (McDonagh et al., 2021). Early conceptualizations of digital competence drew from multiple traditions. Gilster (1997) framed digital literacy primarily as an extension of computer and information literacy, which focused on operational skills and the ability to use hardware and software effectively. With the growth of the Internet, the concept has expanded to include information literacy, shifting attention from specific devices to the information they handle and emphasizing the ability to locate, evaluate, and use information effectively (Bawden, 2001; Koltay, 2011). As technologies became increasingly networked and participatory, digital literacy emerged as an umbrella concept that encompassed earlier forms while extending to social, cultural, and communicative engagement with technology (Cordell, 2013). Furthermore, in the early 2000s, school-based initiatives often linked digital competence more closely to the media education movement. Media literacy perspectives were incorporated into digital literacy, adding critical and creative dimensions that address how digital media shape meaning, identity, and power relations (Buckingham, 2003, 2015; Koltay, 2011). Frameworks such as Canada's MediaSmarts' *Use, Understand, Create* model have echoed this view to emphasize that individuals advance from functional use to critical understanding and responsible creation in a digital environment (Hoechsmann & DeWaard, 2015). Collectively, these perspectives have positioned digital competence as a multifaceted literacy that encompasses technical proficiency, critical awareness, cultural engagement, and ethical participation in a digitally mediated world (Belshaw, 2012; Ferrari, 2012; Hoechsmann & DeWaard, 2015).

In educational settings, teachers are leaders in fostering students' digital competence (Redecker, 2017). Research has suggested that teachers' digital competence enables them to create more dynamic and interactive learning environments with multimedia resources, educational software, or online platforms (Palacios-Rodríguez et al., 2023), and that those with strong digital competence would promote digital literacy among students (Pérez-Navío et al., 2021). Thus, it is essential for teachers to be equipped with technological skills and the ability to incorporate technology into their teaching practice (Starkey, 2020). While our study focuses on how teacher education programs address digital competencies, we acknowledge the tension between technocratic and humanist orientations of teaching with digital technology. Beyond developing technical proficiency, preparing future teachers also involves fostering critical awareness of technology's social, ethical, and cultural implications.

Several frameworks explore the competencies and skills required by educators to teach with digital technologies. The Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) is frequently adopted to guide teachers' digital competence development in teacher education programs. TPACK emphasizes the necessity for teachers to merge three core knowledge domains: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). It suggests that for teachers to integrate technology in their teaching successfully, they must understand the content and teaching methods, as well as how technology can enhance the learning experience.

However, researchers have identified a few limitations in the TPACK framework (Graham, 2011; McDonagh et al., 2021). Falloon (2020) argued that the TPACK framework lacks explicit reference to ethical and professional issues. To address this gap, Falloon developed the Teacher Digital Competence (TDC) framework, offering a holistic view of digital competence. The TDC framework expands digital competence with two sets of integrated competencies: personal-ethical and personal-professional. Personal-ethical competence emphasizes the necessity for teacher education students to understand and model sustainable, safe, and ethical use of digital resources. Personal-professional competence focuses on teachers' well-developed information literacies and strategically engaging in online professional networks. Falloon emphasized that successful technology integration in teacher education should go beyond understanding content, pedagogy, and technology. It requires TCs to understand how to assist their future students in accessing and using digital resources in a sustainable, safe, and ethical way within diverse, digitally mediated environments. Overall, we view both TPACK and TDC as essential and complementary in framing how teacher education programs can prepare future teachers for technology-enhanced classrooms. This balance of technological and pedagogical skills combined with ethical, professional, and critical awareness of technology use by TCs has informed our analysis of educational technology courses in this paper. This perspective recognizes that developing digital competence extends beyond mastering tools to understanding their educational and societal implications.

Teachers' Training on Educational Technologies in Canada

The 2015 report by MediaSmarts on digital literacy policy and practice across Canada emphasized that understanding digital literacy should move beyond the basic technical skills toward a holistic approach that includes creativity, cultural engagement, and civic participation (Hoechsmann & DeWaard, 2015). A recent systematic review examining professional development programs on digital literacy for teachers and TCs in Canada highlighted that gaps in these dimensions persist (Rong & Estaiteyeh, 2024). Additionally, DeCoito and Estaiteyeh (2022a, 2022b) conducted a mixed-methods study to investigate the transition of grades 1–12 science, technology, engineering, and mathematics (STEM) teachers to online teaching in Ontario and identified a significant gap in prior training in digital technologies among educators. Similarly, Van Nuland et al. (2020) reiterated that there is a need to address essential questions about what technology skills and tools teacher educators will require in the coming decades. Hadziristic (2017) maintained that gaps in TC training hinders their use of technology in innovative ways in their teaching. Research has also highlighted that teachers' attitudes, beliefs, and perceptions of technology usefulness strongly shape their ability to integrate technology (Farjon et al., 2019; Scherer et al., 2019). Overall, these results highlight the need for teacher education programs to seek to advance TCs' digital competence intentionally and strategically.

Despite these challenges, research has documented several successful interventions in teacher education aimed at improving teachers' digital competence across various divisions and teaching subjects in Canada. Hagerman and Coleman (2017) implemented the Digital Hub, an open Web-based professional portfolio strategy, which led to a significant enhancement in digital literacy skills and confidence in technology integration among TCs. Horst et al. (2023) implemented a digital platform that

used mobile technology to enhance the digital competence of secondary TCs in their teacher education program. Moreover, Estaiteyeh et al. (2024) examined the benefits of a technology-enhanced STEM curriculum and pedagogy course on TCs' TPACK and readiness for online teaching. Therefore, it is essential to thoroughly explore current teacher education program practices in Canada to understand how educational technology course settings are structured to support and enhance teachers' digital competence.

Conceptual Framework

Practical applications and early exposure to technology help in shaping a positive digital professional identity among TCs, preparing them to create enriching learning opportunities for their future students (Sillat et al., 2017). The integration of technology in teacher education also increases TCs' confidence in using digital tools and offers them a deeper understanding of incorporating technology into pedagogical practices (Filiz & Kurt, 2022).

Importantly, two main models exist in teacher education programs to promote TCs' digital competence: (a) specialized, stand-alone courses on educational technology, and (b) an infused model in which digital skills are integrated into all courses, especially teaching methods courses. This section discusses the definitions of both approaches, as well as their advantages and limitations, to understand their impact on teacher preparedness.

Stand-Alone Educational Technology Courses

Stand-alone educational technology courses are designed to improve technology proficiency among TCs and enhance their ability to integrate technology effectively into their teaching practice (Wang, 2006). This approach ensures educational technology knowledge is systematic among TCs (Roblyer & Hughes, 2019). These courses allow educators to concentrate deeply on educational technology, such as instructional design, digital tools, and pedagogical methods (Mehlinger & Powers, 2002). Stand-alone courses offer in-depth knowledge and skills specific to educational technology, which allows educators to develop their digital competence and TPACK in a focused approach. Zakrzewski and Newton (2023) also noted significant improvements in TCs' comfort levels with technology and a deeper understanding of the importance of its integration as a result of stand-alone courses.

On the other hand, stand-alone courses have a few limitations. Bakir (2015) presented a qualitative multiple-case study examining practices and barriers in technology implementation at three teacher education programs with stand-alone courses. The results showed that preservice teachers did not benefit from single technology courses because learning in isolation did not provide them with the necessary skills and abilities to integrate technology into their practice. Similarly, Foulger et al. (2015) compared stand-alone courses with a tech-infusion model in a teacher education program. The results demonstrated that stand-alone courses often lack integration with broader content knowledge and pedagogical skills, which can limit their real-world applicability. A report from the United States Department of Education (2017) highlighted that many preservice teacher education graduates felt

unprepared to effectively use technology in the classroom, even though over 80% of the preparation programs in the United States deliver their technology curriculum through stand-alone courses. These findings suggest that while stand-alone courses can be effective in enhancing specific technological skills, they may fall short in fostering TCs' comprehensive technology integration capabilities.

The Technology-Infused Model in Teacher Education

The infused model of educational technology is designed to integrate technology training throughout various teacher education courses (Foulger et al., 2019). The infused approach aligns with the TPACK framework as it integrates technology training directly within course content, making its use more relevant and practically applicable (Koehler et al., 2013). Additionally, it promotes a comprehensive understanding of how technology can enhance TCs' skills in technology use and confidence in applying these skills in educational settings (Mishra & Koehler, 2006). Buss et al. (2015) compared the effects of stand-alone courses and infused strategies in teacher education on teachers' TPACK domain scores. They found that technological knowledge (TK) and technological pedagogical knowledge (TPK) developed more quickly among students in the stand-alone course. Yet, content knowledge (CK) and pedagogical knowledge (PK) developed more rapidly in the technology-infused methods courses. Another 2-year longitudinal mixed method study tracked 71 TCs' understanding and application of TPACK from the start of their training in an infused model until the start of their teaching career. Findings indicated a significant increase in TPACK scores, specifically TCs' technology integration growth (such as using diverse kinds of hardware, software, and Web-based applications to aid students' learning) in coursework and classroom teaching (Buss et al., 2018).

However, challenges also exist within the infused model. Research by Wang (2006) highlighted the difficulty in achieving comprehensive technology integration across all courses within educational institutions. Nelson (2017) added that the effectiveness of technology integration heavily relies on the faculty, particularly those mentor teachers whose TPACK proficiency conditionally influences preservice teachers' intentions to use technology. In concurrence, Foulger et al. (2017) emphasized that teacher educators need to define competencies, including knowledge, skills, and attitudes, to effectively support TCs' integration of technology. Similarly, Admiraal et al. (2017) highlighted the critical role of mentors and teacher educators. Their mixed-method research illustrated that mentors were crucial in fostering preservice teachers' effective use of technology and the development of TPACK competencies. Tondeur et al. (2017) emphasized that technology proficiency and willingness to integrate technology among teacher education faculty pose a significant barrier to the infused model's success. Moreover, Dinc (2019) identified barriers such as inadequate funding, equipment shortages, limited skills, and time constraints, which all pose additional challenges to the successful implementation of the infused model in teacher education programs. Foulger et al. (2019) reflected on their 5-year experience with infusing technology into their teacher education program. They emphasized that the technology infusion process was not an immediate solution; it typically required a commitment of up to five years to fully integrate and yield results. They also highlighted the need for strong administrative support, dedicated resources, personnel, and ongoing professional development for successful implementation.

Given all the above, we do not see both approaches as mutually exclusive. Teacher education programs can complement stand-alone educational technology courses with an infused approach to ensure an effective preparation of TCs for technology-enhanced teaching. It is still important to explore current teacher education programs' practices in Ontario as programs strive to promote TCs' digital competence.

Methods

A qualitative methodology was adopted (Creswell & Creswell, 2023). We conducted an environmental scan to explore how educational technology is integrated into teacher education programs across Ontario. An environmental scan is an effective approach to information gathering for a range of purposes, such as reviewing the current state of services and programs, evaluating community needs, identifying service gaps, assessing professional education and training needs, supporting quality improvement initiatives, and informing program and policy development (Charlton et al., 2019).

The team, comprised of a principal investigator and three research assistants, reviewed preservice teacher education program providers in Ontario on the Ontario College of Teacher Education website. We used publicly available information on the websites of those programs to examine their adopted model(s). Between April and August 2024, two research assistants independently visited each program's website to ensure comprehensive coverage and collected details about all courses offered in each program across three divisions: Primary/Junior (P/J), Junior/Intermediate (J/I), and Intermediate/ Senior (I/S). The research assistants identified whether stand-alone educational technology courses were offered or not. They filled out a structured template to gather data, which included the number of educational technology courses, their course descriptions, number of credits, and whether these courses were required or elective. The team also noted information about non-stand-alone courses that mentioned technology in their descriptions, which hinted at an infused model in technology integration. However, this data was limited and inconsistent. As such, only a few examples of the technology-infused approach were included in the dataset presented as a sample.

After the independent data collection phase, we met to review and confirm the data collection results. This process was crucial for ensuring the accuracy and consistency of the information gathered, allowing for a reliable analysis (Creswell & Creswell, 2023). The collected data were then organized into a spreadsheet for systematic comparison. We calculated the number of institutions offering stand-alone courses across different divisions, noted the number of such courses, and calculated the percentage of programs offering them as either required or elective, or both.

After identifying the stand-alone courses, we obtained their descriptions from each program website and organized them into a structured template. It is important to note that course descriptions were last checked August 2024, as they may have been updated afterwards. We could not find detailed course syllabi online, and hence the reliance on course descriptions. We conducted an in-depth analysis of the course descriptions of the stand-alone courses to gain detailed insights into their content, as part of addressing our second research question. Using an inductive content analysis approach (Schreier, 2013),

one research assistant and the principal investigator independently conducted thematic coding of the course descriptions' contents (Clarke & Braun, 2017). After completing their independent analyses, we all met to unify the emerging themes and ensure the analysis' trustworthiness.

Results

Environmental Scan Findings

The environmental scan included 17 teacher education programs whose language of instruction is English. Table 1 provides an overview of educational technology course offerings in these programs. It is noted that 14 out of 16 Primary/Junior (P/J) programs, 9 out of 12 Junior/Intermediate (J/I) programs, and 9 out of 15 Intermediate/Senior (I/S) programs offer stand-alone courses on educational technology. Moreover, many of these courses are required rather than elective (9 out of 14 P/J programs, 6 out of 9 in J/I programs, and 5 out of 9 in I/S programs). Additionally, most programs offer only one course on educational technology in each division.

Table 1

Overview of Educational Technology Course Offerings in Ontario's Teacher Education Programs

Characteristic	Number of programs		
	P/J	J/I	I/S
Analyzed in this research	16	12	15
Offers stand-alone courses	14	9	9
Offers one course	11	8	4
Offers two courses	1	1	2
Offers three or more courses	2	0	3
Courses are required	9	6	5
Courses are elective	4	3	3
Offers both required and elective courses	1	0	1

Note. P/J = Primary/Junior; J/I = Junior/Intermediate; I/S = Intermediate/Senior.

Analysis of Educational Technology Courses' Description

We analyzed the content of course descriptions available online on the websites of teacher education programs offering stand-alone educational courses. We examined 14 programs within the P/J/I division and 9 programs within the I/S division to identify common themes of stand-alone educational technology courses. Table 2 presents a summary of the emerging themes resulting from this analysis and the frequency of repetition of each theme across programs. The numbers indicated in each

cell represent how many programs cover each theme out of the total number of analyzed teacher education programs.

Table 2

Summary of Educational Technology Course Description Content Analysis

Theme	Frequency in P/J/I programs	Frequency in I/S programs	Total
Strategies for teaching using technology	14/14	9/9	23/23
Digital literacy	9/14	6/9	15/23
Evaluation and assessment	3/14	2/9	5/23
Theories	2/14	2/9	4/23
Online teaching	2/14	1/9	3/23
Education policy and law	2/14	1/9	3/23
Game-based learning	2/14	1/9	3/23
Programming and coding	1/14	1/9	2/23

Note. P/J/I = Primary/Junior/Intermediate; I/S = Intermediate/Senior.

As shown in Table 2, a total of eight themes emerged in the educational technology course descriptions: strategies for teaching using technology, digital literacy, evaluation and assessment, theories, online teaching, education policy and law, game-based learning, and programming/coding. The two most common themes were strategies for teaching using technology and digital literacy. All other themes were mentioned five or fewer times across both P/J/I and I/S programs.

First, with respect to strategies for teaching using technology, all programs in P/J/I and I/S offering stand-alone courses highlighted this theme. This theme refers to technology as a valuable tool in education, used to create a more effective, engaging, and personalized learning environment for students. It involves using various technological tools and resources to enhance the educational teaching and learning processes. It also emphasizes the importance of teachers being innovative and resourceful in their instructional approaches. Three sample course descriptions from the universities' websites follow:

> 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… (Brock University EDBE 8P73, I/S division)

> The goal of the course will be for teacher candidates to build an intelligent and thoughtful disposition towards the use of educational technology in K–12 classrooms… (Queen's University EDST 218, P/J/I division)
>
> This course is designed to offer teachers and administrators the opportunity to use and to implement the many forms of technology in delivering curriculum and instructional content to their students… (Niagara University EDU 498, P/J/I division)

Second, digital literacy was a common theme in 9 of the 14 programs in P/J/I and 6 of the 9 programs in I/S. In these courses, digital literacy refers to the ability to use, understand, and critically evaluate information and technology in various contexts. It encompasses a wide range of skills, knowledge, and attitudes essential for navigating digital environments. It also includes a critical perspective on the use of digital tools for creative and instructional purposes, the impact on mental health, and the consideration of the potential consequences of our actions in the digital world, to make choices that align with ethical principles (Hoechsmann & DeWaard, 2015). Three relevant course descriptions follow:

> The impact of technology and the Internet, particularly social media and the tools of the "Read-Write" web, form a significant portion of the course content. Students will also explore relevant digital hardware and software tools to create, communicate, instruct, and inspire… (Lakehead University Education 3516, P/J/I division)
>
> Teacher candidates engage with a range of tech devices and platforms from a practical stance in order to subsequently analyze classroom implications, including professional standards, laws and policies, the impact of social media on mental health and device use, and evidenced-based practices related to effective uses of technology in the classroom… (Trent University EDUC 4388H, P/J/I division)
>
> This course will address practical and technical knowledge … and the intersections of race, gender, ethnicity, class, ability and culture as they relate to the consumption, production and utilization of technology… (Ontario Tech University EDUC 2401U, P/J/I division)

Third, the evaluation and assessment theme was covered in three programs in P/J/I and two programs in I/S. These courses emphasized how technology could be used to investigate the outcomes of learning experiences and provide timely feedback. This theme includes how educational technology can be integrated into assessment strategies to enhance efficiency and accuracy. An example from one course description follows:

> This course deals with issues of technology, grade-level curricular specificity, classroom management, multicultural content and the construction of tests and other assessments as outlined by the Ontario Ministry of Education relevant to the teaching in this content area. (Niagara University EDU 463B/466E, I/S division)

Fourth, theories were referenced in two P/J/I programs and two I/S programs. This theme refers to connecting educational technology and/or learning theories to practice using educational technology tools. For example, the University of Ottawa course stated:

> Examination of the roles and applications of Information and Communications Technologies in the teaching and learning process; integration of current theories and available tools. (University of Ottawa PED 3119, I/S division)

Fifth, online teaching was referenced in two P/J/I programs and one I/S program. For example, the Wilfrid Laurier University course description stated:

> This course is designed to focus on deepening understanding [of] online learning and technology enhanced teaching and learning… (Wilfrid Laurier University EU441, P/J/I division)

Sixth, the education policy and law theme was mentioned in two P/J/I programs and one I/S program. This theme relates to some education policies and measures regarding technology in teaching and learning. It aims to ensure that technology is used effectively and ethically to enhance educational outcomes while addressing potential challenges and ensuring equitable access. For example, the Trent University course stated:

> Teacher candidates engage with a range of tech devices and platforms from a practical stance in order to subsequently analyze classroom implications, including professional standards, laws and policies… (Trent University EDUC 4388H, I/S division)

Seventh, game-based learning was mentioned in two P/J/I programs and one I/S program. This theme concerns the game-based learning pedagogical approach, which uses video games and game-like elements to enhance learning, engagement, and skill development. For example, one of the Ontario Tech University course descriptions includes the following:

> The purpose of this course is to discuss strategies for integrating digital technologies in the classroom …. The tools and resources available to students will be introduced on a thematic basis …. This includes, but is not limited to: digital presentations, game-based learning, digital storytelling, website design… (Ontario Tech University EDUC 2401U, P/J/I division)

Finally, programming and coding were mentioned in only one P/J/I program and one I/S program. This includes writing computer programs, understanding how coding software works, and applying computational thinking to solve problems. For example, one of the Ontario Tech University course descriptions includes the following:

> By exploring and analyzing an array of child-friendly software aimed at developing the basics of coding and digital communication for K–6 learners, teacher candidates will develop innovative pedagogies for teaching and learning in the 21st century. Topics may include: coding educational games, developing mobile apps, LEGO robotics, and digital storytelling. (Ontario Tech University EDUC 2408U, P/J/I division)

Discussion and Conclusion

Our environmental scan of preservice teacher preparation programs in Ontario revealed a relatively positive outcome being that most teacher education programs feature at least one stand-alone course on educational technology, potentially equipping TCs with essential digital competencies and pedagogical skills (Wang, 2006). This demonstrates an attention to equipping TCs with comprehensive training to ensure they gain a solid foundation in educational technology. This outcome also reflects the compliance of faculties of education to the accreditation requirements laid out by the Ontario College of Teachers (2022), specifically on the "use of information and communication technology as a teaching and learning tool" (p. 15). Moreover, most programs require the stand-alone course rather than offering it as an elective, which further underscores the commitment to providing essential technology training for future teachers.

However, the analysis also revealed that most programs offer only one stand-alone course on educational technology. This indicates a potential limitation in the breadth and depth of content covered in stand-alone courses, as highlighted by Foulger et al. (2015)—a finding that was further confirmed by our subsequent analysis of course content. Moreover, there is limited flexibility in course choices, with only one program providing both required and elective courses. This suggests a potential lack of customization and specialization options for TCs interested in exploring deeper or more specialized aspects of educational technology, including a flexible approach to emerging technology trends such as AI.

Furthermore, analyzing stand-alone educational technology course descriptions highlighted the two most common themes out of eight in total. All programs offering these courses emphasized teaching with technology, hinting at the TPACK framework (Mishra & Koehler, 2006). Also, most programs included promoting TCs' digital literacy and competence (Falloon, 2020) as part of their course descriptions. These two concepts are foundational for TCs to effectively integrate technology into their teaching practices. Overall, this analysis signals a strong emphasis on preparing TCs with essential digital competencies and pedagogical skills required to teach using technology.

On the other hand, the analysis also revealed certain gaps and areas needing improvement. For instance, less than half the programs mentioned the remaining six themes, including online teaching, educational technology theories, digital assessment, and coding. This result indicates an imbalance in the coverage of these concepts despite their importance. Although these concepts may be included in the courses' contents despite not being mentioned in their descriptions, offering just one course on educational technology makes the inclusion of all these concepts very challenging. Also, there was limited attention to critical dimensions of educational technology, including issues such as datafication, privacy, ethics, citizenship, and the influence of corporate agendas on curriculum. Consequently, course instructors may find it challenging to strike a balance between technocratic and humanist orientations when teaching with digital technologies. Finally, the lack of mention of emerging technologies such as AI and immersive technologies was notable. This may also be due to the aforementioned time limitations or the fact that teacher education programs are covering those concepts but have not revised the public-facing course descriptions yet. Therefore, future updates to the variety of course offerings and

the contents of educational technology courses are essential to promote TCs' digital competence and TPACK and advance their readiness for the classrooms of the future.

Limitations

Although we believe this analysis is insightful and beneficial in uncovering details about TCs' preparation in educational technology, a few limitations exist. For instance, this analysis was limited to educational technology course titles and descriptions available on universities' publicly accessible websites. Course outlines and syllabi were not publicly available for analysis. Also, course descriptions and teacher education programs' information were last checked in August 2024, so there may have been updates afterwards. Additionally, no direct contact was made with representatives from the teacher education programs. Anecdotal evidence from a few universities indicates that they incorporated modules on AI in their educational technology courses (Estaiteyeh et al., 2025). However, these changes were not noted in the course descriptions at the time of data collection and analysis. As a result, the findings may not fully capture the depth and breadth of each program. A more in-depth analysis of course syllabi would provide clearer understanding.

This study focused exclusively on Ontario's teacher education programs, which limits the generalizability of the findings. Each province and territory in Canada has different educational policies, structure of teacher education programs, and practices. Therefore, the results do not reflect other regions in Canada.

Finally, the study focused on stand-alone educational technology courses; it may not fully capture how technology is integrated across teacher education in Ontario. This limitation is mainly because it is challenging to evaluate the adoption of the technology-infused approach across different universities. That would require analyzing the detailed contents of all courses in each division across all teacher education programs. For instance, our search yielded a few examples of the technology-infused approach in various subject areas, such as language courses integrating digital storytelling (DeWaard, 2022), digital timelines in STEM education courses (DeCoito & Vacca, 2020), and digital tools in curriculum and assessment courses (Hagerman & Coleman, 2017). As such, a detailed analysis of how the technology-infused approach is being implemented is possible and recommended for further insights on the matter.

Implications and Future Directions

This research is timely given recent developments in educational technologies and the need to reflect on TCs' readiness for technology-enhanced teaching. The research advances the knowledge of teacher education program administrators, teacher educators, and educational researchers in educational technology. This analysis will help determine if the currently available courses are comprehensive and aligned with the teachers' need to integrate technology into their teaching effectively. It will also provide insights into how these courses can be improved to better equip future teachers with digital competence.

This study offers multiple directions for research and curriculum development. Future research can analyze detailed course outlines and syllabi to be obtained through official requests from teacher education programs/faculties of education. Studies can also investigate a broader, cross-provincial analysis to better understand how preservice teachers are trained in educational technology across Canada. Further, there is a need to augment the findings around stand-alone courses and study the technology-infused approach in teacher education programs. As such, future research can address how subject-specific courses in teacher education programs incorporate technology, and whether they attempt to complement/compensate for the contents offered or not offered in stand-alone courses. Moreover, future studies can investigate the impact and effectiveness of stand-alone courses and the infused approach on TCs' digital competence and readiness. Research can explore the successes and challenges teacher educators face in preparing TCs for technology-enhanced teaching, as relevant to the Canadian context. Finally, it is essential to monitor AI integration in teacher education programs and how concepts such as AI literacy are being introduced in educational technology and subject-specific courses.

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