

# Integrating emerging technologies to enhance special education teacher preparation

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## Abstract

**Purpose** – The integration of technology in special education can profoundly enhance student outcomes (Marino *et al.*, 2024a). For instance, assistive technologies such as speech-to-text software and communication devices enable students with disabilities to participate more actively in the learning process (Fernández-Batanero *et al.*, 2022). Additionally, adaptive learning platforms can customize content to meet individual student needs, fostering personalized learning experiences (Contrino *et al.*, 2024). Moreover, technology can support differentiated instruction, equipping teachers to address the diverse learning profiles and capabilities within their classrooms (Unal *et al.*, 2022). Numerous impediments obstruct the efficacious integration of technology in special education training and implementation. These include inadequate access to requisite technological resources, insufficient professional development opportunities and limited administrative support (Brennan *et al.*, 2024). Furthermore, educators frequently encounter difficulties tailoring technology to the distinct needs of their students, necessitating specialized training and sustained support across the teacher education process (Basham *et al.*, 2024; US Department of Education, 2024a).

**Design/methodology/approach** – This manuscript describes how the University of Maine’s (UMaine) Special Education Teacher Preparation Program addressed these challenges in its special education teacher preparation program through a strategic partnership with the National Center on Innovation, Design and Digital Learning’s (CIDDL) Tech Alliance. Sponsored by a grant from the US Department of Education Office of Special Education Programs, the alliance provides technical assistance for teacher preparation programs to improve technology integration and enhance student performance. The case study begins with a description of the CIDDL Center, followed by the demographic trends of Maine’s PK-12 public school students. Next, an analysis of the UMaine program provides insights into its challenges related to these topics. Finally, the outcomes of this case study are discussed.

**Findings** – The administration and faculty reported ten primary barriers to (RQ1): “What are current barriers related to the UMaine Special Education Teacher Preparation Program’s ability to increase the capacity of education technology integration during the teacher preparation program?” In response to (RQ2): “What was the faculty’s base-line knowledge and capacity to leverage technology within the University of Maine College of Education and Human Development (COEHD) special education, educator preparation programs, and other related education programs?” About 80% of faculty surveyed indicated they considered themselves to have moderate to expert knowledge of the use of digital tools when conducting research/literature reviews (e.g. accessing research databases, locating resources, checking for relevance and credibility of sources). About 80% also indicated having moderate to expert knowledge of the use of technology for communications, such as the

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use of digital tools for communication/collaboration (e.g. social media, collegial interactions, communities of practice, etc.). Findings also indicated the following faculty needs, which are consistent with the program needs. (1). Limited understanding of how emergent technology can support students with disabilities. (2). Limited knowledge to incorporate Universal Design for Learning during courses taught by professors outside special education. (3). Limited knowledge and abilities to conduct student clinical observations at a distance using technology. In response to (RQ3): “In what ways could the special education program support sustainable strategies to increase innovative technology practices to support positive outcomes for preservice teachers and their future PK-12 students with and without disabilities?” Findings indicated the need for a clear vision at the college and program level of how different types of technology (e.g. assistive technologies, virtual reality, augmented reality and artificial intelligence) could be integrated in the coursework.

**Research limitations/implications** – This exploratory case study examined UMaine’s Special Education Teacher Preparation Program and its collaboration with the national CIDDL as part of a Tech Alliance initiative. Researchers employed a practice-oriented design (Ebneyamini and Sadeghi Moghadam, 2018) that incorporated multiple data sources, contextual analysis and both qualitative and quantitative data to ascertain the educator preparation program needs related to equipping teachers to utilize technology. The research is limited in that it addresses only one program in the United States. However, the Tech Alliance included ten programs.

**Practical implications** – The barriers noted for research question one are common across educator preparation programs (EPPs) throughout developed nations (Kerkoff and Cloud, 2020). For example, a study by Williams *et al.* (2023) indicated the influence of EPP program culture in relation to supporting teacher candidates’ growth is critical as they progress through technology-infused teacher preparation. Additionally, Karchmer-Klein *et al.* (2021) found that specifically developing teachers technological, pedagogical and content knowledge (TPACK) was crucial, yet not enough to lead to sustained technology integration across teachers’ pedagogical practice in the long term. The authors noted that although participants in their study perceived technology as important, there was a mismatch between this belief and the actual integration of technological tools into their teaching practice (Karchmer-Klein *et al.*, 2021). The lack of access to assessment methods using technology and the integrated use of UDL in course design are also common barriers (Graziano *et al.*, 2023; Marino *et al.*, 2024b; Weisberg and Dawson, 2023). Graziano and colleagues identified key pillars that EPPs should strive for: (1) technology integrated coursework throughout their EPP curriculum, (2) faculty-modeled experiences, (3) opportunities to practice with reflection and (4) fostering of technology self-efficacy amongst EPP students. Likewise, Weisberg and Dawson (2023) noted two pedagogical styles were particularly beneficial for students in EPPs: (1) leveraging technology to teach about equitable and socially just access to education for all learners and (2) adopting a critical stance toward the role of technology integration in schools through modeling digital equity pedagogy.

**Social implications** – The integration of emerging technologies, such as artificial intelligence, in special education, as demonstrated by the University of Maine’s program, provides a transformative model that can be adopted worldwide. The necessity of comprehensive professional development and strategic collaboration is emphasized, aligning with global trends toward inclusive education and promoting equitable learning opportunities (Contrino *et al.*, 2024; Fernández-Batanero *et al.*, 2022). The use of assistive technologies, adaptive learning platforms and digital resources in special education is crucial for addressing the diverse learning needs of students with disabilities, making this model relevant and replicable in various educational contexts internationally. Barriers identified in the manuscript, such as limited access to technological resources, insufficient professional development and lack of administrative support, resonate with challenges faced by educational institutions globally. Addressing these challenges through strategic partnerships, as exemplified by the collaboration with the CIDDL, offers a framework for enhancing infrastructure and faculty capabilities internationally (Brennan *et al.*, 2024; Gangone and Fenwick, 2024). Building digital literacy among teacher candidates and integrating Universal Design for Learning (UDL) principles into curricula fosters a more inclusive and technology-driven approach to special education, encouraging global educational stakeholders to prioritize similar strategies within their own contexts (Marino *et al.*, 2024b).

**Originality/value** – The findings of this exploratory case study underscore the critical importance of integrating emerging technologies into special education teacher preparation programs. UMaine’s collaboration with CIDDL demonstrated that strategic partnerships and targeted professional development can significantly enhance the digital readiness of preservice teachers. This study noted comprehensive professional development, sustained support and the adoption of UDL principles are essential for equipping educators with the skills necessary to effectively incorporate technology into their teaching practices.

**Keywords** Special education teacher preparation, Center for innovation, Design, Digital learning, Professional development, Technology

**Paper type** Case study

## Introduction

Teacher preparation programs frequently fail to adequately incorporate technology integration, predominantly emphasizing conventional pedagogical techniques (Dieker *et al.*, 2024). For instance, Klein (2023) indicated that a minimal proportion of these programs offer

extensive technology training. This deficiency results in educators who are insufficiently prepared to utilize assistive technologies, adaptive learning platforms, and digital resources to accommodate diverse learning requirements (Gangone and Fenwick, 2024).

The integration of technology in special education can profoundly enhance student outcomes (Marino *et al.*, 2024a). For instance, assistive technologies such as speech-to-text software and communication devices enable students with disabilities to participate more actively in the learning process (Fernández-Batanero *et al.*, 2022). Additionally, adaptive learning platforms can customize content to meet individual student needs, fostering personalized learning experiences (Contrino *et al.*, 2024). Moreover, technology can support differentiated instruction, equipping teachers to address the diverse learning profiles and capabilities within their classrooms (Unal *et al.*, 2022).

Numerous impediments obstruct the efficacious integration of technology in special education training and implementation. These include inadequate access to requisite technological resources, insufficient professional development opportunities, and limited administrative support (Brennan *et al.*, 2024). Furthermore, educators frequently encounter difficulties tailoring technology to the distinct needs of their students, necessitating specialized training and sustained support across the teacher education process (Basham *et al.*, 2024; US Department of Education, 2024a).

This manuscript describes how the University of Maine's (UMaine) Special Education Teacher Preparation Program addressed these challenges in its special education teacher preparation program through a strategic partnership with the National Center on Innovation, Design, and Digital Learning's (CIDDL) Tech Alliance. Sponsored by a grant from the US Department of Education Office of Special Education Programs, the alliance provides technical assistance for teacher preparation programs to improve technology integration and enhance student performance. The case study begins with a description of the CIDDL Center, followed by the demographic trends of Maine's PK-12 public school students. Next, an analysis of the UMaine program provides insights into its challenges related to these topics. Finally, the outcomes of this case study are discussed.

### **CIDDL center tech alliance purpose and description**

The Center for Innovation, Design, and Digital Learning is a national center, sponsored by the Office of Special Education Programs at the US Department of Education. Its objective is to increase knowledge, adoption, and use of a range of educational technologies by increasing capacity in teacher preparation programs, particularly for individuals with disabilities. CIDDL's mission promotes innovation and design in digital learning environments through professional learning networks to support inclusive education. The CIDDL Tech Alliance leverages the work at the center by strategically supporting ten institutions and organizations focused on special education teacher preparation spanning the United States.

Key initiatives of CIDDL include:

- (1) *Research and development*: Conducting cutting-edge research on the application of educational technology in special education. This involves developing and testing new digital tools and instructional methods tailored to diverse learners' needs.
- (2) *Professional development*: Offering face-to-face training programs and virtual resources for educators to enhance their skills by integrating technology into their teaching practices. In addition, CIDDL provides webinars, workshops, and online courses focused on effective technology use in special education.
- (3) *Collaboration and partnerships*: Fostering partnerships with educational institutions, technology developers, and policymakers to promote best practices and drive systemic change in educational technology. CIDDL collaborates with stakeholders to ensure innovations are grounded in research and meet the practical needs of educators and students through the [CIDDL Community](#) portal.

- (4) *Resource repository*: Maintaining a comprehensive repository of resources, including research articles, instructional guides, and case studies. These resources serve as valuable tools for educators, administrators, and researchers seeking to improve their understanding and application of educational technology.
- (5) *Advocacy and policy*: CIDDL engages in advocacy efforts to influence educational policies that support technology integration in special education. CIDDL aims to ensure inclusive policies and equitable access to digital learning resources for all students.

CIDDL is promoting the vision of inclusive and innovative learning environments for individuals with disabilities. CIDDL seeks to bridge the gap between research and practice, fostering a more inclusive and technologically adept educational landscape. Each institution or organization in the Tech Alliance developed a unique plan of action for improvement based on its unique challenges and growth areas described in subsequent sections. One of these member institutions is UMaine's Special Education Teacher Preparation Program. The follow section describes this work through the lens of an exploratory case study.

### Research questions

The primary questions guiding this exploratory case study were:

- RQ1. What are current barriers related to the UMaine Special Education Teacher Preparation Program's ability to increase the capacity of education technology integration during the teacher preparation program?
- RQ2. What was the faculty's base-line knowledge and capacity to leverage technology within the University of Maine College of Education and Human Development (COEHD) special education, educator preparation programs, and other related education programs?
- RQ3. In what ways could the special education program support sustainable strategies to increase innovative technology practices to support positive outcomes for preservice teachers and their future PK-12 students with and without disabilities?

### Method

#### *Exploratory case study design*

Case studies constitute an important methodological approach in special education research, offering insights into the intricate dynamics and outcomes of educational policies, programs, and practices (Mahdi *et al.*, 2020). The methodology facilitates examination of instances within authentic contexts, exploring how educational strategies impact individuals with disabilities and the professionals supporting them (Priya, 2021). By using this methodology, researchers can discern the nuanced experiences of participants, including students, educators, and teacher preparation personnel, thereby enriching the comprehension of educational phenomena (Sibbald *et al.*, 2021). This method permits the investigation of variables in naturalistic settings, revealing perspectives that quantitative methodologies might overlook, such as the subjective experiences of individuals or the complexities inherent when implementing innovative practices (Makri and Neely, 2021).

This exploratory case study examined UMaine's graduate-level Special Education Teacher Preparation Program and its collaboration with CIDDL as part of a Tech Alliance initiative. Researchers employed a practice-oriented design (Ebneyamini and Sadeghi Moghadam, 2018) that incorporated multiple data sources, contextual analysis, and both qualitative and quantitative data to ascertain the educator preparation program needs related to equipping teachers to utilize technology.

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An exploratory case study was utilized because the research was investigating new, complex, or insufficiently understood phenomena (Yin, 2018). Exploratory case studies are ideal when the research seeks to answer “how” or “why” questions in a real-world context where the boundaries between the phenomenon and its context may be blurred (Creswell and Poth, 2018). This methodology allows the researcher to gather in-depth insights and explore variables and dynamics that might not be fully conceptualized beforehand. Exploratory case studies are particularly useful for investigating novel or poorly understood topics, understanding contextual factors, and capturing complexity (Merriam and Tisdell, 2016).

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### *Demographics across Maine schools*

Maine has a large physical footprint encompassing 33,215 square miles in the Northeast United States. It has a relatively small population when compared to other states in New England with nearly four million residents. Maine is a rural state, with approximately 66% of the population living in four of the 16 counties. These populations represent the metropolitan areas of Portland, Lewiston, Bangor, Auburn, and their corresponding towns (Maine.gov, 2023).

In addition, Maine has 26 urban areas; 5 urbanized areas and 21 urban clusters US Census Bureau (2021). Maine’s diverse landscape incorporates 525 towns and cities separated by forests, beaches, rivers, and other landforms and bodies of water. The average town had 5,257 residents in 2020, with an average household income of \$68,000. Maine’s schools’ range in size from fewer than ten students to over 1,000 (Maine Department of Education (MDOE, 2024b)). Over half of Maine’s public schools are in rural locations, with an additional 17% categorized as being in towns (NCES, 2018). Maine has 26 urban areas: 5 urbanized areas and 21 urban clusters. (NCES, 2018; US Census Bureau, 2021). The most populated cities in Maine are Portland with 69,104, Lewiston at 38,404, Bangor with 31,628, South Portland at 26,840, and Auburn with 24,793 (Carney, 2024).

### *Enrollment trends*

The information below describes key demographic aspects of Maine’s PK-12 (i.e. pre-kindergarten through twelfth grade) schools and students. As of the 2023–2024 school year, 172,622 students were enrolled in Maine public schools across grade levels (MDOE, 2024a). Slightly over 20% of these students are identified as students with disabilities (MDOE, 2024b). This number is substantially higher than the national average of 15% reported in the 45th Annual Report to Congress on the Implementation of the Individuals with Disabilities Education Act (US Department of Education, 2024). Overall public school enrollment has slowly decreased over the last decade, while the number of students with disabilities has increased (MDOE, 2024a).

### *Teacher shortages*

According to the Maine Policy Institute (2024), Maine is facing a dire teacher shortage. In their report, researchers stated that in 2022, 1,311 educators quit public service and 927 retired. This coincides with a sharp uptick in resignations among public school educators beginning in 2020.

### *Racial and ethnic composition*

From 2010 to 2020, every county in Maine experienced growth in racial and ethnic diversity of the child population (Maine Children’s Alliance, 2024). Maine was one of three states in the US with an increase greater than 50% in children of color between 2010 and 2020 in Census Data (O’Hare and Mayol-Garcia, 2023). During this time, Maine also experienced a 17% decline in white children, resulting in a rural state with a child population that is increasingly more diverse than the adult population. The Maine Department of Education’s student

enrollment data in [Table 1](#) indicates similar trends. Interestingly, public schools in Maine have seen a significant increase in three groups: Black students, Latino students, and students of two or more races. Maine has the highest percentage of Black multilingual learners in the country at 61%. Most come from Angola, Somalia, Brazil, and other African and Latin American countries that are experiencing significant social and political turmoil ([MDOE, 2024d](#)). Given these trends, it is important for districts and schools throughout the state to ensure their system’s responsiveness for racially and ethnically diverse students and their families.

*Linguistic diversity*

Maine’s public schools are also experiencing increased linguistic diversity, specifically in their multilingual learner population. Multilingual learners are students who speak home languages other than English and require language acquisition services (i.e. English for speakers of other languages) to access academic content and build skills. In 2023–2024, multilingual learners represented 4.2% of the PK-12 student population ([MDOE, 2024d](#)). This population’s linguistic diversity is unique compared to most of the US. In 2023–2024, the top six home languages spoken by multilingual families based on the number of students were Portuguese, Somali, Spanish, Arabic, French, and Lingala ([MDOE, 2024d](#)). Of these home languages, Maine’s public schools have seen the highest percentage difference in the Portuguese-speaking student population, with a 42.4% increase, and in the Lingala-speaking population, with a 25.1% increase from 2023 to 2024. UMaine trains special educators to use emergent technologies to meet the linguistic needs of Maine’s students. This diverse and rich linguistic profile is important to acknowledge as part of the teacher preparation process ([US Department of Education, 2024b](#)).

*Socioeconomic status*

During the 2023–2024 school year, 38% of Maine’s PK-12 students were economically disadvantaged ([MDOE, 2024a](#)). The [National Center for Educational Statistics \(2022\)](#) reported the national average of students who are economically disadvantaged is 51%. Mississippi had the highest with 78% and New Hampshire had the lowest with 20.8%. The designator of economic disadvantage is eligibility for free or reduced-price lunch, which represents students eligible for these resources due to family income or other factors, such as living in a household that receives support through the Supplemental Nutrition Assistance Program ([Morris and Johnson, 2019](#)). Two percent of its students were unhoused in Maine, which is similar to the national average of 2.2% ([MDOE, 2024a](#); [National Center for Homeless Education, 2022](#)). These numbers underscore the need for supportive educational policies and resources that respond to the economic disparities in Maine.

**Table 1.** Racial and ethnic student demographic data in 2015 and 2024

Race or ethnicity	2015	2024
Asian	2,752	2,251
Black	5,905	8,440
Indigenous	1,440	1,322
Latino*	3,540	6,003
Native Hawaiian or other pacific islander	194	157
Two or more races	3,419	6,509
White	165,581	147,940

**Note(s):** \*Student ethnic data is aggregated with race when it should be separate. Therefore, the racial composition of Maine’s Latino students is not represented here

**Source(s):** Table by authors

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### *University of Maine special education teacher preparation program*

The University of Maine, with its flagship campus in Orono and six other campuses across Maine, is the state's land, space, and sea grant research university. Its online [Master of Education in Special Education](#) program prepares students to provide high-quality education to all students with unique learning, social-emotional, communication, and other needs. The master's program includes five areas of concentration: early intervention/early childhood, low incidence disabilities, high incidence disabilities, dual concentration of high and low incidence disabilities, and an individualized concentration. Additional special education programs include the following graduate certificates: (1) adapted physical education; (2) autism spectrum disorder; (3) high leverage practices to promote inclusion; (4) multilingual special education; (5) Positive Behavior Intervention and Support; (6) special education leadership; and (7) transition leadership. Finally, an education specialist program in special education is available. This program requires 30 credits past the master's degree. Upon program completion of the degree or certificate, students seeking initial certification can apply through the MDOE or their state's Department of Education for special education certification. This is completed using a transcript review process matching the state's licensure coursework and credit hour requirements to a student's completed coursework.

### *Establishing baseline program data*

A Digital Readiness Framework and Assessment Tool was developed to establish baseline data for educator preparation programs participating in the CIDDL Tech Alliance. This tool aimed to provide a framework and process for collecting and reporting baseline data. The data were subsequently used for planning purposes among the 10 Tech Alliance institutions and organizations. These plans were designed to improve instructional technology access, planning, instruction, and practices for special education preservice teachers.

The assessment tool was organized around a CIDDL Technology Readiness Framework for higher education preparation programs, informed by the Metiri Range of Technology Use model (CIDDL, 2023). The CIDDL framework and tool addressed areas of Institutional Leadership, Departmental Readiness, Infrastructure, Effective Use of Digital Learning in preparation programs, Faculty's Digital Knowledge and Innovation, and Preservice Teachers' Knowledge and Effective Use of Technology.

Once developed and refined through a Delphi process (Shang, 2023), the CIDDL evaluator designed survey questions targeting college administrators, teaching faculty, preservice teachers, field coordinators, and student interns. CIDDL Principal Investigators reviewed, refined, and uploaded the surveys into the Verint Survey System. Survey items included Likert scale responses, frequency counts, and open-ended responses. Survey links and instructions were provided to Tech Alliance members for a survey window from September 13 to September 30, 2023. Surveys were administered to constituents throughout the organization including preservice students, general and special education faculty, staff, and members of the administration. Each constituent received a unique question set designed to address technology: knowledge, use, capacity, and systems change. Individual dynamic reports were developed in Looker Studio for the Tech Alliance members. These reports were accessible prior to an in-person Tech Alliance planning meeting at the University of Kansas on October 12–13, 2023, and updated for those who extended data collection into November 2023.

After the survey window closed and data collection was complete, the data were cleaned and linked to a Looker Studio dynamic report designed by CIDDL. Each Tech Alliance member team received a separate report displaying survey results in charts, tables, and lists of open-ended responses, organized around the CIDDL framework's five areas. In sections related to effective technology use in preservice programs, faculty and preservice teacher results were displayed side-by-side for subgroup comparisons. Filters were provided throughout the reports to enable dynamic views of the data based on subgroup comparisons.

The special education program coordinator at each institution attended an in-person meeting involving the 10 partnerships in the CIDDL Tech Alliance. During this meeting, members collaborated with at least two other special education faculty members at similar institutions to identify barriers to education technology integration (RQ1), report base-line knowledge of their faculty, administration, staff, and students (RQ2), and develop a sustainable technology integration plan within their teacher preparation classes (RQ3).

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### *Data analysis*

Descriptive statistics and frequency distributions were used across stakeholder groups (e.g. students, faculty, administrators) to summarize the Likert scale survey item responses. Qualitative data analysis of the open-ended survey responses involved a systematic and rigorous process aimed at identifying patterns, themes, and meanings within the non-numeric data. Once the data was collected, researchers immersed themselves in the data through repeated readings to gain a deep understanding of the content. This initial stage, often referred to as familiarization, set the foundation for subsequent analysis (Creswell and Poth, 2018).

The next step involved coding the data. Coding entails labeling segments of the data with descriptive tags that capture the essence of the information. These codes can be descriptive, reflecting the surface content, or interpretive, capturing underlying meanings (Saldaña, 2016). The coding process for this exploratory study was inductive, where codes emerged directly from the data. Following coding, researchers engaged in categorization, where similar codes were grouped into broader categories or themes. This step involved constant comparison and member checking to ensure consistency and coherence in the emerging themes (Charmaz, 2014). Researchers remained reflexive, continually questioning their interpretations and considering alternative explanations.

The final stages of qualitative data analysis involved identifying overarching patterns and constructing a narrative linking these patterns to the research questions. This synthesis required a thorough understanding of the context and a critical examination of the data to ensure the findings were both credible and trustworthy (Lincoln and Guba, 1985). Triangulation, member checking, and peer debriefing were employed to enhance the validity and reliability of the findings (Patton, 2015).

## **Results**

### *Program areas of strength*

The CIDDL survey was sent to faculty in the University of Maine's educator preparation program, including the special education online master's degree. Respondents represented COEHD administration, faculty in special education, and a random selection of preservice teachers. The following areas were noted as areas of strength for institutional technology readiness to support the educator preparation program: (1) the UMaine campus provided modern digital teaching stations for use by faculty in classrooms, (2) UMaine had robust campus wide Wi-Fi available for faculty and student use, (3) The Instructional Technology Department offered a range of supported applications for faculty and student use, and (4) UMaine established a set of privacy and security policies to govern technology use.

### *RQ1: Special education program area needs*

The administration and faculty reported ten primary barriers to (RQ1): "What are current barriers related to the UMaine Special Education Teacher Preparation Program's ability to increase the capacity of education technology integration during the teacher preparation program?" Survey data indicated the barriers in Table 2.

UMaine teacher education students who responded to the survey reported their college coursework had limitations as well. These are indicated in Table 3.

**Table 2.** Barriers reported by faculty in the program

Priority	Barrier description
1	Limited time to design effective technology integration in their coursework
2	The designated number of credit hours available did not allow for additional coursework focused on emergent technologies
3	A lack of clear state-level expectations or standards surrounding emergent technology integration and usage
4	Limited access to technologies for all preservice teachers, especially those from lower socio-economic status
5	Limited digital literacy of teacher candidates in the program
6	A lack of a community of professionals dedicated to learning collaboratively about the integration of education technology in courses

**Source(s):** Table by authors

**Table 3.** Barriers reported by preservice and inservice teachers in the program

Priority	Barrier description
1	Few opportunities to design instruction using technologies that are commonly found in Maine schools
2	Limited experience using technology during PK-12 classroom instruction
3	Lack of experience using technology to assess student knowledge
4	Limited technology integration within assignments. For example, during a class on applied behavior analysis the technology became the focus of the assignment rather than the behavior change mechanisms for the student
5	Lack of Universal Design for Learning in courses where it was taught as a method. For example, instructors were teaching about UDL without providing multiple means of representation for assignment directions and outcomes

**Source(s):** Table by authors

### *RQ2: Faculty baseline knowledge*

In response to (RQ2): “What was the faculty’s base-line knowledge and capacity to leverage technology within the University of Maine College of Education and Human Development (COEHD) special education, educator preparation programs, and other related education programs?” Eighty percent of faculty surveyed indicated they considered themselves as having moderate to expert knowledge of the use of digital tools when conducting research/literature reviews (e.g. accessing research databases, locating resources, checking for relevance and credibility of sources. Eighty percent also indicated having moderate to expert knowledge of the use of technology for communications such as the use of digital tools for communication/collaboration (e.g. social media, collegial interactions, communities of practice, etc.).

Findings also indicated the following faculty needs, which are consistent with the program needs:

- (1) Limited understanding of how emergent technology can support students with disabilities.
- (2) Limited knowledge to incorporate Universal Design for Learning during courses taught by professors outside special education.
- (3) Limited knowledge and abilities to conduct student clinical observations at a distance using technology.

*RQ3: Sustainable strategies*

In response to (RQ3): “In what ways could the special education program support sustainable strategies to increase innovative technology practices to support positive outcomes for preservice teachers and their future PK-12 students with and without disabilities?” Findings indicated the need for a clear vision at the college and program level of how different types of technology (e.g. assistive technologies, virtual reality, augmented reality, and artificial intelligence) could be integrated in the coursework.

*Action steps to enhance program outcomes*

A series of goals and intended outcomes were collaboratively designed with input from faculty, administration, and CIDDL Tech Alliance colleagues. The project aimed to address the following needs during the 2023–2024 academic year:

- (1) Increase capacity for technology integration in coursework
- (2) Implement practical applications of technology into syllabi
- (3) Explore technology-based instructional tools
- (4) Share ideas and resources during monthly professional development meetings that could benefit students in all teacher preparation programs at the graduate and undergraduate levels

A team of UMaine faculty, which included general and special education faculty and administration, outlined a series of activities for the 2023–2024 academic year to achieve these four goals. First, the team met with COEHD deans and the school director to debrief after the in-person CIDDL Tech Alliance meeting. Second, they conducted ongoing collaboration with the administrative team, dean’s faculty advisory committee, and the school’s curriculum committee to develop a vision for how technology integration would lead to increasing the value to the teacher preparation program. Third, the team implemented monthly professional development opportunities for faculty and students to learn more about UDL and technology integration. Fourth, they participated in a collaborative process with the Maine Center for Inclusive Technology in Education (<https://mainecite.org/about/>) to provide professional development opportunities for in-service and pre-service teachers.

**Discussion**

The barriers noted for research question one are common across Educator Preparation Programs (EPPs) throughout developed nations (Kerkoff and Cloud, 2020, 2023). For example, a study by Williams *et al.* (2023) indicated the influence of EPP program culture in relation to supporting teacher candidates’ growth is critical as they progress through technology-infused teacher preparation. Additionally, Karchmer-Klein *et al.* (2021) found that specifically developing teachers technological, pedagogical, and content knowledge (TPACK) was crucial, yet not enough to lead to sustained technology integration across teachers’ pedagogical practice in the long term. The authors noted that although participants in their study perceived technology as important, there was a mismatch between this belief and the actual integration of technological tools into their teaching practice (Karchmer-Klein *et al.*, 2021).

The lack of access to assessment methods using technology and the integrated use of UDL in course design are also common barriers (Graziano *et al.*, 2023; Marino *et al.*, 2024b; Weisberg and Dawson, 2023). Graziano and colleagues identified key pillars that EPPs should strive for: (1) technology integrated coursework throughout their EPP curriculum, (2) faculty-modeled experiences, (3) opportunities to practice with reflection, and (4) fostering of technology self-efficacy amongst EPP students. Likewise, Weisberg and Dawson (2023) noted two pedagogical styles were particularly beneficial for students in EPPs: (1) leveraging

technology to teach about equitable and socially just access to education for all learners, and (2) adopting a critical stance toward the role of technology integration in schools through modeling digital equity pedagogy.

As a result of the action steps in [RQ3](#), the faculty of the UMaine COEHD as a whole and the special education program developed a plan for dual certification and preparing teachers to educate all learners. The special education faculty also worked with the CEEDAR Center to design the dual certification pathways at the state level (i.e. elementary and special education). The new coursework sequence for dual certification focuses on UDL and technology use across all educator preparation programs ([Flanagan et al., 2022](#)).

Several leverage points were identified to advance the project's objectives of enhancing preservice teacher training with integrated technology. For example, monthly professional development meetings with COEHD administrators and experts from the CIDDL community led to a plan for course revision and further technology integration in special education methods courses. In the fall of 2023, discussions between instructional technology and special education led to the integration of tools to support all students' learning during School of Learning and Teaching or COEHD events ([Kaczorowski and Howorth, 2021](#); [Flanagan et al., 2022](#)). The special education faculty participating in the CIDDL tech alliance completed syllabus revisions to model the use of technology to differentiate instruction effectively. In addition, special education faculty are working with UMaine instructional technology administration to alleviate the paperwork associated with allowing online student teachers and other school professionals to freely access resources through their school districts.

These outcomes reflect two of the pillars outlined by Garziano and colleagues (2023): (1) opportunity to practice with reflection, and (2) technology integrated coursework throughout the EPP. As an EPP, UMaine is working to create additional opportunities for students to experience faculty-modeled technology integration, including opportunities to foster technology self-efficacy amongst in service and preservice teachers in our EPP. In the next year, the faculty plan to revise their syllabi across the program, aligning coursework with best-practice technology integration.

Special education program faculty plan to utilize the tips outline by [Weisberg and Dawson \(2023\)](#), leveraging technology to teach about equitable and socially just access to education for all learners. Faculty will do this by having ongoing time dedicated at school and department meetings for colleagues to share how they are adopting a critical stance toward the role of technology integration in schools through modeling digital equity pedagogy. These "technology taster" conversations will keep conversations light, ongoing, and meaningful. Their addition to meeting agendas will also help keep faculty accountable, knowing they will be sharing their pedagogical innovations at each meeting.

### **International implications**

The integration of emerging technologies, such as artificial intelligence, in special education, as demonstrated by the University of Maine's program, provides a transformative model that can be adopted worldwide. The necessity of comprehensive professional development and strategic collaboration is emphasized, aligning with global trends towards inclusive education and promoting equitable learning opportunities ([Contrino et al., 2024](#); [Fernández-Batanero et al., 2022](#)). The use of assistive technologies, adaptive learning platforms, and digital resources in special education is crucial for addressing the diverse learning needs of students with disabilities, making this model relevant and replicable in various educational contexts internationally.

Barriers identified in the manuscript, such as limited access to technological resources, insufficient professional development, and lack of administrative support, resonate with challenges faced by educational institutions globally. Addressing these challenges through strategic partnerships, as exemplified by the collaboration with the Center for Innovation Design and Digital Learning (CIDDL), offers a framework for enhancing infrastructure and

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faculty capabilities internationally (Brennan *et al.*, 2024; Gangone and Fenwick, 2024). Building digital literacy among teacher candidates and integrating Universal Design for Learning (UDL) principles into curricula fosters a more inclusive and technology-driven approach to special education, encouraging global educational stakeholders to prioritize similar strategies within their own contexts (Marino *et al.*, 2024b).

The manuscript's findings emphasize the importance of policy advocacy and the role of educational technology in supporting students with disabilities, which has broader implications for shaping international educational policies and practices. The detailed successes and challenges provide valuable insights for policymakers and educators worldwide, highlighting the need for systemic support and sustained investment in educational technologies (Graziano *et al.*, 2023; Weisberg and Dawson, 2023). By advocating for inclusive policies and equitable access to digital learning resources, the manuscript contributes to the global discourse on improving special education through technology, inspiring international efforts to adopt innovative and research-based approaches in teacher preparation programs (Dieker *et al.*, 2024).

### Conclusion

The findings of this exploratory case study underscore the critical importance of integrating emerging technologies into special education teacher preparation programs. UMaine's collaboration with CIDDL demonstrated that strategic partnerships and targeted professional development can significantly enhance the digital readiness of preservice teachers. This study noted comprehensive professional development, sustained support, and the adoption of UDL principles are essential for equipping educators with the skills necessary to effectively incorporate technology into their teaching practices.

Faculty and administrative feedback revealed several barriers to effective technology integration, including limited time for course redesign, insufficient digital literacy among teacher candidates, and a lack of clear state-level standards. Addressing these challenges requires a systemic approach including ongoing professional development, access to technological resources, and collaborative efforts to create a culture of continuous improvement in digital competency (CIDDL, 2024). The insights gained from the survey responses and subsequent data analysis provide a roadmap for overcoming these obstacles and fostering a more technology-rich educational environment.

The study also revealed significant strengths within the University of Maine's program, such as robust campus-wide Wi-Fi, modern digital teaching stations, and a supportive instructional technology department. These assets serve as a strong foundation for further enhancing the integration of educational technologies. The successful implementation of monthly professional development meetings and the collaboration with CIDDL experts exemplify the potential for institutional initiatives to drive meaningful change in teacher preparation programs. These efforts not only improve the digital readiness of faculty and students but also promote a more inclusive and engaging learning environment for all students.

Looking ahead, UMaine plans to build on these successes by revising syllabi to ensure consistent technology integration and by fostering a culture of innovation through "technology taster" conversations. These strategies aim to enhance the self-efficacy of preservice teachers in using technology to support diverse learners. The ongoing collaboration with CIDDL and other stakeholders will be crucial in sustaining these efforts and achieving long-term improvements in special education teacher preparation.

In conclusion, this case study provides valuable insights into the effective integration of technology in special education teacher preparation programs. By addressing identified barriers and leveraging existing strengths, UMaine has made significant strides in enhancing digital competency among its educators. The findings emphasize the need for ongoing professional development, strategic partnerships, and a commitment to continuous

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improvement to ensure that preservice teachers are well-equipped to utilize technology in ways that support and engage all students, particularly those with disabilities.

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