# Building technology integration at an urban school through a PDS partnership



Patrice Silver, Juliann Dupuis, Rachel E. Durham, Ryan Schaaf and Lisa Pallett
*School of Education, Notre Dame of Maryland University, Baltimore, Maryland, USA, and*
Lauren Watson
*John Ruhrah Elementary/Middle School, Baltimore, Maryland, USA*

Received 14 October 2023
Revised 18 January 2024
5 February 2024
Accepted 12 February 2024

## Abstract

**Purpose** – In 2022, the Baltimore professional development school (PDS) partner schools, John Ruhruh Elementary/Middle School (JREMS) and Notre Dame of Maryland University (NDMU) received funds through a Maryland Educational Emergency Revitalization (MEER) grant to determine (a) to what extent additional resources and professional development would increase JREMS teachers' efficacy in technology integration and (b) to what extent NDMU professional development in the form of workshops and self-paced computer science modules would result in greater use of technology in the JREMS K-8 classrooms. Results indicated a statistically significant improvement in both teacher comfort with technology and integrated use of technology in instruction.

**Design/methodology/approach** – Survey data were collected on teacher-stated comfort with technology before and after grant implementation. Teachers' use of technology was also measured by unannounced classroom visits by administration before and after the grant implementation and through artifacts teachers submitted during NDMU professional development modules.

**Findings** – Results showing significant increases in self-efficacy with technology along with teacher integration of technology exemplify the benefits of a PDS partnership.

**Originality/value** – This initiative was original in its approach to teacher development by replacing required teacher professional development with an invitation to participate and an incentive for participation (a personal MacBook) that met the stated needs of teachers. Teacher motivation was strong because teammates in a strong PDS partnership provided the necessary supports to induce changes in teacher self-efficacy.

**Keywords** Classroom technology use, Teacher comfort with technology, Teacher efficacy in technology, Teacher motivation in technology use, Technology integration in K-12 classrooms

**Paper type** Research paper



The researchers for this article would like to acknowledge the work and leadership of Dean Kathryn Doherty of NDMU, who wrote the MEER grant for the partnership and provided outstanding leadership throughout the project. Additionally, the researchers would like to acknowledge the exceptional work done by Stephanie and Sean Grimes in the creation and teaching of the computer science modules. The authors also extend their deep gratitude to the instructional staff at JREMS for their participation in this work and unwavering commitment to the families of the JREMS community.

*Funding:* The researchers would like to acknowledge the Maryland Department of Housing and Community Development (DHCD) who administered the Maryland Education Emergency Revitalization (MEER) grant through the Office of Statewide Broadband (OSB).

School-University Partnerships
Emerald Publishing Limited
e-ISSN: 2833-2075
p-ISSN: 1935-7125
DOI 10.1108/SUP-10-2023-0041

## Introduction

As technologies evolve at a rapid pace, the demands on teachers to provide education that prepares students for success become increasingly critical (Henderson & Corry, 2021). During the year immediately following the post Covid-19 pandemic, many teachers reported exhaustion (Marshall *et al.*, 2022). This teacher discouragement, along with growing expectations to stay current with new technologies can lead to demotivation that often surfaces as resistance to change (Henderson & Corry, 2021). Additionally, when teachers perceive technology to be too complex, they are more apt to indicate that it is not useful and are less likely to use technology in their instruction (Teo, 2009).

While there may be barriers to implementing change and overcoming teacher adversity to using new technologies, schools can be supported to increase teacher efficacy and use of technology. One such support is a professional development school (PDS) partnership. This partnership provides the ideal vehicle for advancing change in the area of technology instruction. The university partner shares current research and instructional strategies, while the K–12 school provides the environment and practical teaching experience to put research into practice. Of the PDS Nine Essentials, this collaborative effort is supported by Essential 3 – Professional Learning and Leading, wherein "A PDS is a context for continuous professional learning and leading for all participants, guided by need and a spirit and practice of inquiry" (NAPDS, 2021, p. 15). This study examines the effects of utilizing a PDS partnership to improve both teacher comfort and teacher use of technology in an urban K–8 school with a high population of English language learners (ELLs) during the post-Covid era.

## Background

Notre Dame of Maryland University (NDMU) and John Ruhrah Elementary/Middle School (JREMS) have been PDS partners for over 20 years. In that time, they have worked to exemplify the nine essentials that guide a PDS partnership (NAPDS, 2021) as they have supported interns and teachers and have collaboratively addressed the needs of both institutions. For example, in 2020, this PDS partnership secured a grant that provided hot spots, devices and school materials to all JREMS students during the Covid lockdown, exemplifying Essential 9: Resources and Recognition (NAPDS, 2021). It also provided tuition for teachers to take various classes at NDMU, including one created for the partnership that provided Spanish for teachers and advocacy for immigrant families. The creation of this Spanish/Advocacy class by partners, teachers and the NDMU professor (see Savick *et al.*, 2022) is an example of the implementation of Essential 4: Reflection and Innovation (NAPDS, 2021).

In 2022, JREMS received a low score on a mock student effectiveness review (SER) walkthrough in the area of teacher use of technology in the classroom. Rater comments indicated that teachers rarely went beyond using technology as a power point projection system during instruction. Teachers were already exhausted and discouraged from a year of post-Covid remedial instruction and disciplinary challenges. Administrators identified integration of technology aligned with International Society for Technology in Education (ISTE) Standards as an area for improvement and prioritized this topic in their work with their PDS partner, NDMU, during the 2022–2023 academic year. The site coordinator at JREMS and liaison [1] from NDMU met to determine how the partnership could best address the need for instruction that integrated technology into teaching while supporting teachers. Additionally, JREMS administration conducted an informal online survey of teachers and staff to determine how they would most feel supported. Survey results from teachers indicated that they would feel most supported by receiving a personal laptop for school use. In light of the need for supporting increased teacher technology use, an application was submitted and awarded by the Maryland Educational Emergency Revitalization (MEER) grant to revitalize technology integration at this urban community school. The grant funds were used to meet the teacher-stated need of providing personal laptops for teachers in exchange for their full participation in professional development workshops and online technology modules. As part of the grant, survey data were collected from teachers measuring their level of comfort with technology use before and after the grant implementation. Teachers' use of technology was also measured by unannounced classroom visits by a JREMS administrator before and after the grant implementation.

*Description of partner institutions*

JREMS, originally constructed in 1930 as P.S. 228, was renamed in honor of a Baltimore pediatrician, John Ruhrah, known internationally for his work in pediatric medicine (Garrison, 1935). The newly renovated 21st Century school is located in Southeast Baltimore City in a neighborhood known as Greektown. Designation as a 21st Century Building indicates that the school has been renovated with flexible learning areas created for interaction and collaboration and technology-equipped classrooms (21st Century Schools: Baltimore, 2023). As part of the Baltimore City Public School System, the school is recognized as Title I with over 95% of the students living below the poverty line. Throughout its history, this elementary/middle school has been a vital part of the immigrant community. JREMS has the largest English Language Learner (ELL) population of all Baltimore City Public Schools. Of the 1,005 students who attended the school in 2022–2023, 854 reported speaking a language other than English at home. The dominant ethnic group is Hispanic, with 894 students identifying as Hispanic, while only 18 students identify as White non-Hispanic and 46 students as Black/African-American. Approximately 70% of the students receive English for speakers of other languages (ESOL) services (Baltimore City Public Schools, 2023). To fully support the whole child, JREMS became a community school in 2016. A community school is designed to support underserved students by partnering with community organizations and local government to provide a focus on not just academic needs of the students, but also health and social services, along with youth and community development (Oakes *et al.*, 2017). The school's partnerships with NDMU, the Judy Center Early Learning Center Hub and Baltimore's Southeast Community Development Cooperation have marshaled a substantial amount of resources and services to support JREMS students' social and learning experiences (Savick *et al.*, 2022).

NDMU is an institution with a long history devoted to preparing students for careers in education. The University has provided educational opportunities to students in Maryland since its founding by the School Sisters of Notre Dame in 1895. Located in Baltimore, Maryland, NDMU was the first women's college in the nation to award the four-year baccalaureate degree. Throughout its 125-year history, NDMU's commitment to the mission "to educate leaders to transform the world," (NDMU, 2023) has continuously provided quality higher education to underserved populations.

NDMU's School of Education (SoE) provides both undergraduate and graduate degrees and certificates, accelerated programs and programs in teacher-shortage fields such as STEM, TESOL and special education (Dupuis *et al.*, 2023). Teacher candidates who complete a traditional full-term internship experience, participate in two different placements; one in a PDS partner site, such as JREMS, and the second in either another PDS or non-PDS site. Participation in a PDS partnership aligns with the mission of NDMU, as many interns experience an increased appreciation of inclusive communities as they experience urban schools for the first time. NDMU also addresses its mission to serve others as it partners with PDS schools both for the success of the interns and for the school community.

The partnership of NDMU and JREMS realized that to bring about the desired change in technology integration, the project needed to address various hurdles in teacher acceptance. These hurdles included needed changes in teacher attitudes, anxiety and self-efficacy (Corry & Stella, 2018; Henderson & Corry, 2021; Teo, 2009).

## Review of the literature

Technology innovation continues to evolve at a rapid pace. The rate at which technology is integrated into educational settings also continues to grow, adding to what educators must master to be effective in the classroom. While teachers are usually experts in their specific content areas, they often have to adjust to the new on-trend technologies (Henderson & Corry, 2021). Educators balance many responsibilities, oftentimes causing emotional drain that can be interpreted as being resistant to change (Henderson & Corry, 2021). With any adoption of new curriculum, technology or intervention, there will be an adjustment period that may engender changes in attitudes, anxiety levels and self-efficacy (Corry & Stella, 2018; Henderson & Corry, 2021; Teo, 2009).

### *Teacher attitudes toward technology*

As with most initiatives, if something is useful and easy to use, then use is more likely. When it is difficult to use and there is no support, use is less likely or occurs less often (Teo, 2009). This phenomenon was noted in a study of pre-service educators and their attitudes toward the use of technology. Teo (2009) studied the attitudes of 475 pre-service teachers at the National Institute of Education in Singapore. Participants were surveyed on seven variables: "behavioural intention, attitudes towards computer use, perceived usefulness, perceived ease of use, computer self-efficacy, technological complexity, and facilitating conditions" (Teo, 2009, p. 305). Specifically, when "technology is perceived to be useful and using it would improve their performance and make them more efficient, pre-service teachers are more likely to use technology" (p. 309). When the participants noted having positive feelings toward the use of computers, they also reported being more likely to continue using the technology in a more substantial way, assuming positive attitudes continued. An additional finding was that pre-service educators also perceived that adequate support (e.g. technical, personnel) enabled users to apply technology efficiently and effectively and actually had a greater influence on pre-service educators' perceptions of the amount of effort necessary, vs actual level of productivity or efficiency (Teo, 2009). Overall, the findings suggest "that when users perceive a technology to be complex, they tend to find the technology less useful in that they would be unlikely to be productive and efficient by using it" (Teo, 2009, p. 309).

In a study by Mouza *et al.* (2022), the impact of a research-based professional development program on teacher learning and classroom practice in computer science education was investigated. Their mixed-methods study involving 94 K-12 educators from across the United States utilized pre/post surveys, interviews and weekly reflection journals to measure growth in content knowledge, pedagogy and technology integration. The findings indicated that the professional development program effectively enhanced teacher knowledge and practice, particularly in content knowledge, pedagogy and technology integration. Additionally, the study identified specific program design features that facilitated changes in teacher learning and practice, including hands-on activities, collaboration, reflection and ongoing support. A meta-analysis by Huang *et al.* (2022) examined K-12 STEM teacher professional development programs, focusing on knowledge foci, professional development approaches, outcome measurements and data sources used in these programs. The study revealed that the most frequently reported approaches in STEM professional development were learning by design, scaffolding authentic experiences, collaborating with peers and reflecting on practice. While educator professional development can be provided in various ways, studies (Sablić *et al.*, 2020; Weng *et al.*, 2023) have demonstrated the potential for growth through video-based and hands-on experiences in professional learning. For example, Weng *et al.* (2023) conducted a meta-analysis of 30 qualifying studies that examined the effectiveness of video-based learning (VBL) activities in enhancing the professional competencies of pre-service teachers. The findings revealed that VBL activities had a significant positive effect on the development of content knowledge, psychological characteristics such as teaching beliefs and efficacy, and practical experience. Similarly, Sablić *et al.* (2020) conducted a meta-analysis of 39 studies exploring video-based learning for professional development. The results indicated that more educators are utilizing video-based learning due to its ease of distribution and widespread applicability.

The use of technology in the classroom can be helpful in most cases; however, there are instances when teachers feel pressured to use a new technology with which they may not be familiar or comfortable. The pressure to utilize the technology may actually be detrimental to the educator, causing them anxiety and frustration.

### *Technology and teacher anxiety*

With the increased pressure to meet the needs of all students and accomplish all tasks set forth in the curriculum, teachers are faced with various competing demands that include integrating the newest and trendiest technology. Through this integration, teachers have been identified as having fear of technology use in general, but also frustration during the integration process (Henderson & Corry, 2021). In an analysis of 45 peer-reviewed articles published between 2008 and 2018 focusing on K-12 and higher education teacher anxiety from changes in technology, Henderson and Corry (2021) found that a major theme emerged centered on adaptability. "Building computer self-efficacy is believed to be one possible way to reduce anxiety and build more confident and adaptable teachers" (Henderson & Corry, 2021, p. 583).

The research stressed the need for teacher training programs to include numerous technology experiences within the coursework and during their internship in order to increase technological self-efficacy and decrease anxiety associated with technology integration. Two questions of importance that emerged from the research and are relevant to our study and teacher preparation program: "How do we prepare teachers to be adaptable with educational technology? How can training programmes focus on preparing teachers for change while balancing emotion?" (Henderson & Corry, 2021, p. 584). As a means to measure the adaptability of educators with regard to the use of technology in the classroom, the information technology integration self-efficacy of educators can be investigated.

### *Teacher self-efficacy and technology integration*

Educators need to be able to call upon their professional knowledge in both content and pedagogy to effectively perform in the classroom. While the inclusion of technology enables interactive activities, it may not positively correlate to the quality of teaching provided (Zeng *et al.*, 2022). In addition, the relationship between teachers' technology integration self-efficacy and teachers' knowledge needs to be taken into account by school systems and educator training programs so as to attend to differing individual needs and increase both skills and self-efficacy (Zeng *et al.*, 2022).

Bandura defines self-efficacy as "beliefs in one's capacity to organize and execute the courses of action required to produce given attainments" (Bandura, 1997, p. 3). Bandura identified two expectancies: self-efficacy and outcome efficacy. Efficacy expectation "is the conviction that one can successfully execute the behavior required to produce the outcomes (Bandura, 1997, p. 193), whereas outcome efficacy is defined as "a person's estimate that a given behavior will lead to certain outcomes" (Bandura, 1997, p. 193). Bandura argues that,

> Outcome and efficacy expectations are differentiated, because individuals can believe that a particular course of action can produce certain outcomes, but if they entertain serious doubts about whether they can perform the necessary activities such information does not influence their behavior. (Bandura, 1997, p. 193)

Given the framework of self-efficacy presented by Bandura, educators must be able to see how certain actions (i.e. learning new technology and its integration into the curriculum) can produce certain positive outcomes in their classroom, as well as feel confident in their skills to use the technology effectively.

Zeng *et al.* (2022) conducted a meta-analysis of 28 studies focusing on the relationship between teachers' information technology integration self-efficacy and technology pedagogical and content knowledge (TPACK; Thompson & Mishra, 2007). The results of the review, which included 7,777 subjects, showed that "teachers' information technology integration self-efficacy is significantly positively correlated with TPACK ($r = 0.607, p < 0.001$), indicating that teachers' self-efficacy with information technology integration is closely related to TPACK" (Zeng *et al.*, 2022, p. 7). The authors contend that "the improvement of teachers' information technology integration self-efficacy has higher requirements for the information technology environment at the school level, and in turn, it also affects the information technology environment at school" (Zeng *et al.*, 2022, p. 8). Overall findings were in favor of a positive relationship between teachers' technology integration self-efficacy and their pedagogical knowledge surrounding the use of technology. Through training and support, teachers' TPACK levels can be increased, therefore improving teachers' technology integration self-efficacy.

The overview of literature presented provides a framework for the current investigation. Data from teacher self-reported surveys and reflections from assignments and classroom visits were used to measure the connection between the professional development provided through the NDMU PDS partnership and teacher attitudes toward technology, self-efficacy and technology integration.

## Design

To increase teacher technology integration in the classroom, teacher self-efficacy was emphasized in the partnership's application for grant funding. The MEER grant, administered under The Maryland Department of Housing and Community Development (DHCD) through the Office of Statewide Broadband (OSB), provided $350,000 to the NDMU/JREMS professional development school partnership. The goals of the grant were to:

(1) Provide all JREMS teachers and teacher assistants with new laptops, laptop connection adapters and associated technology accessories to support technology enhanced teaching and learning in their classrooms.

(2) Provide JREMS teachers, teacher assistants and interns with access to best practice pedagogy and subject matter experts in technology-enhanced instruction for ELLs by offering access to live-streamed professional development courses from the NDMU Global Technology Classroom.

The NDMU/JREMS MEER grant project was implemented during a three-month technology and facility enhancement period running from June 1, 2022 – September 1, 2022, followed by a one-year pilot school year program in which the technology was utilized to enhance teaching and learning through professional development sessions offered by NDMU affiliates.

Two project co-directors (one NDMU faculty member and one JREMS administrator) oversaw the overall administration of the project. Based on needs assessment data from JREMS, new MacBook laptops and adapters were purchased and distributed for each teacher, teacher assistant and intern, along with connection adaptors. Air Pod Pros were purchased and allocated to teachers working on ESL instruction to facilitate clear pronunciation and phonics when streaming online. Additionally, a Global Classroom was created at NDMU, which included a projection system, smart lectern station, video system and professional installation. The global classroom was designed to provide capabilities for live streaming professional development instruction to JREMS teachers and teacher assistants on topics such as blended learning and best practice methods in ELL teaching and learning.

The principal at John Ruhrah met with all JREMS faculty, staff and interns at the start of the school year to familiarize them with the MEER grant project and to encourage them to dedicate themselves to a school-wide emphasis on enhanced instruction through technology. Every participant in the project was offered a personal MacBook for full participation in the professional development sessions and technology modules. All teachers, staff and interns volunteered to participate in the training and receive a personal MacBook.

An evaluation plan included a combination of self-assessments and observations. Participants completed surveys at the beginning and end of the project to report on their efficacy with technology integration in instruction. Additionally, all participants were observed and evaluated on their technology usage in instruction by unannounced observations by a JREMS administrator in September and April. See the Methods and Data section for a detailed explanation of data collection and results. Data analysis was conducted by an NDMU SoE faculty member in her role as grant evaluator.

## Description of initiatives

The ISTE standards for educators (2023) serve as a guiding framework for technology integration in education, offering a comprehensive blueprint for effective technological use in global schools. Rooted in educational research and practitioner insights, these standards are intended to ensure that technology enhances learning by fostering high-impact, sustainable, scalable and equitable educational experiences for all students. For the current study, the NDMU and JREMS leadership team implemented a multifaceted training initiative aligned with the ISTE Standards for Educators and aimed at enriching the technological and pedagogical skills of educators at JREMS. One of the primary initiatives in this partnership involved delivering a combination of traditional face-to-face professional development sessions with just-in-time video-based instruction. By bridging these two modalities, educators at JREMS were provided with a comprehensive support system designed to elevate their instructional capabilities. Furthermore, the implementation plan utilized a series of online, asynchronous technology-focused professional development modules to promote professional growth and development in critical content areas, particularly coding and programming. These modules were constructed to meet the needs of busy educators, while simultaneously offering them opportunities for professional growth and development. A general timeline of all professional activities is provided in Table 1, Timeline of PD Program, with a detailed description of each session provided in the following section.

### *Professional development sessions*

Teacher time and energy are invaluable professional resources in the field of education. To better serve students and the learning community, the professional development at JREMS required a customized curriculum and delivery method tailored to the unique needs of its educators. As part of the MEER grant, in August 2022, JREMS staff received new Apple MacBook Air laptops and participated in a face-to-face MacBook bootcamp. Building upon the framework provided by Mouza *et al.* (2022), the bootcamp consisted of two mandatory 90-min workshops held in the school's media center. Participants brought their laptops for a collaborative and hands-on training experience. The bootcamp focused on exploring the functionality of the new laptops, including pre-installed MacOS software.

The curriculum focused on device care and maintenance, MacOS file management, universal access features, introduction to native apps, troubleshooting and connecting MacBooks to presentation peripheral devices. To facilitate information and resource dissemination, an accompanying website was created using Google Sites (https://sites.google.com/view/mac-101-for-connected-educator/home), serving as a modular delivery method for further training materials and pre/post-program survey administration.

Table 1.
Timeline of PD program

| Timeframe | Professional activities | Modality | Assessment | Personnel involved | Rationale |
|---|---|---|---|---|---|
| September, 2022 | Unannounced observation of teachers | FTF | Recorded Notes | JREMS Administration | Provide Baseline Data |
| September, 2022 | Teacher Survey | Online | Recorded Notes | JREMS Administration | Provide Baseline Data |
| September, 2022 | Initial MacBook Training | FTF | Teacher survey | NDMU Faculty | Efficient MacBook Use |
| October, 2022 | Blended Learning | Online | Teacher created blended learning lesson created and delivered | NDMU Faculty | Teacher technology integration in instruction |
| Nov, 2022 - Feb. 2023 | Computer Science Modules | Online | Computer science lesson plan and reflection | NDMU Faculty | Teacher computer science integration in instruction |
| April, 2023 | Technology for English Language Learning | Online | Teacher reflection on use of strategies during the month after training | NDMU Faculty | Technology integration for English language learners |
| April, 2022 | Teacher Survey | Online | Recorded Notes | JREMS Administration | Provide Data |
| April, 2022 | Unannounced observation of teachers | FTF | Recorded Notes | JREMS Administration | Provide Data |

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

To support educators following the initial face-to-face MacBook bootcamp throughout the 2022–2023 academic year, a series of asynchronous video-based professional developments were produced by NDMU faculty. These videos were initiated to avoid the limitations often inherent in one-off professional development programs. Darling-Hammond *et al.* (2017) identify a lack of time to learn, practice and reflect on new strategies that facilitate change in teaching practices as barriers to professional development. In addition to the asynchronous supports, JREMS leadership and NDMU faculty provided specific digital learning opportunities throughout the year. During the JREMS professional development program, participants were required to design innovative learning experiences (learn by design), scaffold authentic learning experiences (particularly for ELLs), collaborate with colleagues and engage in reflective practice.

The first topic centered around exploring the new applications available on the new laptops. The subsequent topic involved educators learning about designing and facilitating HyperDoc experiences. Highfill *et al.* (2016) defined HyperDocs as transformative, interactive Google Docs that replace traditional worksheets by creating logical learning progressions, curating quality digital resources and engaging learners. All JREMS educators and staff were required to develop grade and subject-appropriate HyperDoc experiences and reflect on their implementation. NDMU faculty provided feedback and suggestions to improve the design of the HyperDocs, offering crucial ongoing support as recommended by Mouza *et al.* (2022). The final professional development topic focused on integrating technology tools for instructional support of ELLs. After watching a related video, JREMS educators and staff were tasked with implementing strategies to support ELL students and reflecting upon the experience, aligning with the literature (Huang *et al.*, 2022; Mouza *et al.*, 2022).

The face-to-face and video-based professional development series constituted just two facets of the multifaceted initiatives crafted for the educators and staff at JREMS.

Additionally, the collaboration with NDMU faculty also yielded a comprehensive catalog of four computer science-based professional development modules, presenting a wide array of topics and ideas. These modules described subsequently aim to empower JREMS educators and staff with an extensive toolkit to integrate computer science principles into their instructional programs.

*Technology modules*

The four modules consisting of 3D design, circuits and coding, coding and computational thinking were developed collaboratively with faculty and experts in technology education. The modules were designed to provide the teachers with background knowledge, resources and hands-on practice in these key areas while providing adequate support, which has been found to increase teacher's attitudes (Teo, 2009) and self-efficacy (Henderson & Corry, 2021) toward technology use. The modules each had five sessions and were estimated to take approximately 15 hours for participants to complete asynchronously. Module topics were selected in consultation with technology education experts in the field due to their relevance and ease of use for teachers who may experience anxiety and low self-efficacy related to technology use in the classroom. Teachers completing the modules had access to a computer provided by the grant as well as the following hardware, software and materials to complete the modules.

(1) Tinkercad© – a free app that introduces students to 3D design and coding

(2) Makey Makey Classic Kit – an invention kit that enables the user to turn everyday objects into touchpads using a basic knowledge of circuits

(3) Circuit Playground Express – a small microcontroller board designed for beginner programmers

(4) MakeCode – a web-based code editor for physical computing with the Circuit Playground Express

(5) Scratch – a free web-based coding platform for beginners

(6) Code.org – a non-profit organization that provides a free web-based coding platform for beginners

The first module, 3D design, included background information for the participants on 3D design. Upon completion of the sessions, participants were able to define 3D design and identify a pathway of teaching and learning activities that moved from 2D to 3D design and 3D printing. Activities in the first session included videos and resources to provide teachers with background on what 3D modeling is and what it is used for, how 3D printing can be used in education, careers in 3D printing and how 3D printers work. Next, participants completed a module on the educational applications of 3D design. In this session, participants identified the benefits of implementing 3D design into instructional practice, discussed educational applications for 3D design and 3D printing in K-12 classrooms, and had the opportunity to review authentic K-12 student projects that utilize 3D design and 3D printing. In Sessions 3 and 4, participants learned to use Tinkercad© for 3D design and how to utilize Tinkercad© in the classroom with students. These sessions provided tutorials, hands-on practice using the software tool, as well as suggestions for how to integrate Tinkercad© into instruction. At the end of Module 3, participants used Tinkercad© to create a landmark of their choice. After completing Modules 3 and 4, participants developed a lesson plan utilizing 3D design that aligns with the curriculum at their school.

The second module, circuits and coding, provided participants with background knowledge on how to integrate circuits and coding. The sessions in the module provided participants with an opportunity to learn about best practices for coding and circuitry into their curriculum using Makey Makey© and Circuit Playground Express©. In Session 1, participants were guided through activities to ensure they could define circuits, understand a simple circuit and identify the benefits of integrating Makey Makey into the K-12 curriculum. Participants had the opportunity to discuss the educational applications of Makey Makey within the K-12 classroom setting and review a variety of authentic student projects that utilized Makey Makey. In Session 2, participants learned about the electronic components of the kit, how to set up and use Makey Makey, and how to integrate Makey Makey with Scratch, an online coding platform. Sessions 3 and 4 provided participants with background information on programmable circuits and Circuit Playground Express. They discussed the educational applications of Circuit Playground Express and how it could be used in K-12 classrooms and how the MakeCode platform could be integrated with Circuit Playground Express. At the end of the module, participants created a fully-functional, curriculum aligned activity that used either Makey Makey© or Circuit Playground Express© with their students.

In Module 3, participants continued to explore coding as they learned best practices for integrating coding activities and skills through the use of coding platforms Code.org and Scratch. In Session 1, participants learned about coding, computational thinking, computer science, programming and computing as well as the benefits of integrating coding into instructional practice. Next, participants completed Session 2 in which they learned how to use Code.org. In Session 3, participants learned about "debugging," an essential skill for learning code. They participated in activities that assisted them in understanding the significance of "debugging" as a skill and how to teach "debugging" to students. Next, participants learned to code with Scratch©. They completed activities which helped them understand how to use Scratch© and the key features of the platform and understand how to use the platform with K-12 students. The module culminated with a project in which participants demonstrated their ability to design, teach and reflect on a lesson that implemented coding with their students.

The final module focused on computational thinking. The first session provided participants with background information on computational thinking and the relationship between computational thinking, computer science and computing. Then, participants learned about the benefits of implementing computational thinking activities into instructional practice. Activities provided them with the background to define the core skills of computational thinking and provided them with examples of how these skills can be found outside of computer science. In the next session, participants learned about "unplugged" activities, computational thinking activities that do not require a computer. Participants learned about and explored a variety of "unplugged activities," then completed a final project in which they designed, taught and reflected on a lesson that implemented unplugged activities to teach computational thinking.

In summary, the modules were developed to address the need at JREMS to better prepare the teachers to integrate technology into their instruction, including the following: 3D design, circuits and coding, coding and computational thinking. Following the implementation of the study, participants were tasked with integrating technology learned into instruction. Measurement of the increase of teacher efficacy after completing the modules and the resultant increase in their use of technology to teach are described in the following sections.

## Methods and data collection

The research questions addressed in this study include:

(1) To what extent did additional resources and professional development increase JREMS teachers' efficacy in technology integration?

(2) To what extent and in what ways did efforts result in greater integration of technology in JREMS K-8 classrooms?

Three sources of data were collected to address the research questions. First, a survey capturing technology self-efficacy was administered to JREMS staff at the beginning (September 19–20, 2022) and end of the school year (April 25-May 5, 2023). The survey instrument is attached as Appendix. Second, classroom walkthrough data were collected in September and April to identify instances of learning activities that were utilizing technology. Finally, qualitative data were gathered from teachers' submissions over the course of participation in NDMU's professional development modules.

The survey instrument was lightly adapted from a validated instrument developed by Computer Science for All Teachers (Schwarzhaupt *et al.*, 2021), which measured computer science teaching self-efficacy. For the current construct, technology self-efficacy, question stems remained the same but the question topic was adapted to general technology and technology integration. The survey represents two subscales: (a) comfort with technology and (b) teaching with technology and one total technology efficacy scale.

Responses collected at each time point were determined to be reliable measures of the two subscales and total scale, as presented in Table 2. Questions in the comfort with technology subscale included, e.g. "I think my computer skills will never surpass basic knowledge" and "The idea that in the future schools will be more strongly influenced by technology makes me anxious." Example questions from the teaching with technology subscale include, "I understand technology well enough to be effective in teaching my students to use it, too" and "I can create learning activities that use technology at the appropriate level for my students." Response options included a 5-point Likert scale from 1 = strongly disagree to 5 = strongly agree. At the beginning of the year, virtually all instructional staff including coaches and paraprofessionals participated in the survey ($n$ = 109), while approximately 75% ($n$ = 79) completed the end of year survey. Two NDMU interns placed in JREMS participated in the professional development and are represented in the data along with all other instructional staff.

The second research question concerning integration of technology in instruction was answered using two sources of data. First, teacher submissions throughout their participation in the professional learning modules were collected as artifacts. These artifacts represent lesson components that teachers used with students in the classroom. Second, a JREMS administrator who was a member of the project team performed drop-in classroom visits in September and again in April to check whether the current learning activity involved the use of technology by the teacher, students or both. At each time point, the team member dropped in during three different days in at least one classroom per grade, kindergarten through eighth. A total of 27 observations were collected at each time point. If the activity involved technology usage by either teachers or students, the classroom scored 1, or 0 if no technology was being used. Comments were also captured regarding the type of learning activity taking place. For example, if students were engaged in a learning activity or an assessment using their Chromebooks, or if students were working in the computer activity center, the classroom scored 1. If, however, students were working entirely with paper and

| | Beginning of year | End of year | |
|---|---|---|---|
| | Cronbach's α | | Numb. Items |
| Comfort with technology | 0.814 | 0.679 | 4 |
| Teaching with technology | 0.878 | 0.901 | 7 |
| Total technology efficacy | 0.900 | 0.881 | 11 |
| *N* | 102 | 79 | |

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

**Table 2.** Reliability estimates, technology integration efficacy scale and subscales

pencil or the teacher was not observed using technology to deliver instruction, the classroom scored 0. All scores were tallied at each time point to compute a total for both the beginning and end of year to examine whether frequency of technology integration changed during the school year.

The analysis to respond to the first research question employed descriptive and bivariate means comparison tests to determine whether technology efficacy was significantly different between the beginning and end of the year. Classroom observation data were also analyzed descriptively. Teacher professional development submissions were analyzed qualitatively by one NDMU faculty member of the project team using content analysis applying *a priori* codes corresponding to the ISTE Educator Standards (ISTE, 2023). The standards represent recommended ways that teachers should apply technology to teaching and learning in classrooms.

### *Findings*

As an initial step, the survey data were cleaned to check for duplicate entries, missing values and to recode several reverse-scale questions so that a higher score reflected more positive self-perceptions. The data were also examined to ensure subscales were normally distributed before performing the main analysis.

To address the first research question regarding the extent to which targeted professional development was associated with changes in teachers' technology self-efficacy, mean scores were compared using *t*-tests. As presented in Table 3, mean subscale scores for both comfort with technology and teaching with technology increased from the beginning to the end of the year and differences were statistically significant. Specifically, the mean for comfort with technology increased from 3.69 (SD = 0.83) to 3.94 (SD = 0.64; $t = 2.28$, $p = 0.024$). The mean for teaching with technology increased from 3.63 (SD = 0.66) to 4.00 (SD = 0.61; $t = 3.39$, $p < 0.001$). The mean increase for the total scale was also statistically significant (refer to Table 3).

An investigation of whether teachers used technology more frequently in student instruction by the conclusion of the school year found that of the 27 observations collected in September, only 14 (51.9%) featured technology integration. Observations completed in April indicated that 24 out of 27 (88.8%) classes of students were engaged in activities using technology, representing a substantial increase. Further, effective technology integration was present with both submissions from JREMS educators during the professional development sessions and computer science modules, as well as in reflections they offered. The following findings are organized by specific ISTE Standards for Educators (2023) used as a framework for content analysis (refer to Table 4).

### *Blended learning training*

ISTE Standard 2.2 requires educators to implement new digital tools during the learning process, while 2.3 calls for mentoring students in the safe use of these tools while learning. The artifact analysis revealed that 96% of JREMS educators curated and employed quality

**Table 3.** Comparison of beginning and end of year technology integration efficacy scales

| | Beginning of year Mean (SD) | End of year Mean (SD) | Mean diff | *t*-test | *p*-value |
|---|---|---|---|---|---|
| Comfort with technology | 3.69 (0.83) | 3.94 (0.64) | 0.25 | 2.28 | 0.024 |
| Teaching with technology | 3.63 (0.66) | 4.00 (0.61) | 0.37 | 3.39 | <0.001 |
| Total technology efficacy | 3.65 (0.66) | 3.98 (0.55) | 0.33 | 3.64 | <0.001 |

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

**Table 4.** Qualitative a priori codes aligned with ISTE standards and notable examples of blended learning and ELL technology artifacts

| A priori codes | ISTE Standard for Educators | Percent of Occurrences in Artifacts (%) | Notable example |
|---|---|---|---|
| Connecting Learners to Quality Web Resources (HQIMs) | 2.2 & 2.3 | 96 | • *Farm Animals* HyperDoc<br>• *Circuits* HyperDoc |
| Collaboration with Teachers and Peers | 2.4 | 68 | • Rhyming Activity<br>• Littering *Flip* Activity<br>• Use of *Class Dojo* and *Vocaroo* |
| Publishing and Presenting New Knowledge | 2.5 & 2.6 | 25 | • Littering *Flip* Activity<br>• *Circuits* HyperDoc |
| Promoting Learner Agency and Choice | 2.6 | 45 | • *Bitmoji* classroom<br>• Learner Playlists<br>• *YouTube* videos |
| Multimedia Expressions | 2.6 | 31 | • Safe Stair Walking videos<br>• Story Map for *Little Boo* |
| Methods for Collecting and Organizing Data | 2.7 | 70 | • *Google Jamboard* exit tickets<br>• *Google Form* exit tickets |
| Using Authentic Learning and Assessment Techniques | 2.5 & 2.7 | 28 | • *Bud, Not Buddy* HyperDoc<br>• Eastern Woodland Tribes Diagrams<br>• Save the Bay |

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

web resources to support their instructional goals. The integration of quality web resources and the cultivation of collaboration among educational stakeholders are central tenets of the ISTE Standards for Educators (2023). Complementing this, the Maryland State Department of Education (2023) articulated a strategic imperative for educators to identify and utilize high-quality instructional materials (HQIM) that bolster the educational experiences of all Maryland students. Bugler *et al.* (2017) recommended instructional resources be up-to-date, accessible and user-friendly. During the content analysis, the researcher used these criteria to evaluate the teacher artifacts. Notable practices included a kindergarten educator's creation of a *Farm Animals* HyperDoc, engaging students in farm-related content exploration through diverse web-based activities. Furthermore, a science educator designed a circuits HyperDoc, integrating resources from *Kids Britannica*, YouTube and Prezi. Based on the evidence in the artifacts, most educators at JREMS curated a wide variety of digital resources and planned for the safe and effective use of these resources during learning.

ISTE Standard 2.4 requires educators to use collaborative tools to expand students' authentic, real-world learning experiences. Laal and Ghodsi (2012) defined collaborative learning (CL) as an instructional method where learners at various performance levels work together in small groups toward a common goal. For the purpose of this study, NDMU researchers also included evidence of the teacher engaging in or facilitating class or group discussions since they can also participate in collaborative learning activities. Collaborative learning, central to ISTE Educator Standard 2.4, was featured in 68% of the HyperDoc artifacts. Educators fostered collaboration through activities like teacher-led discussions, group discussions and digital cooperative learning tasks. For instance, a kindergarten HyperDoc encouraged rhyming word sharing among students and a third-grade educator-initiated video discussions on the environmental impact of littering using Flip (formerly FlipGrid). These notable examples of technology integration fostered collaboration among students and their teachers.

ISTE Standard 2.5 requires educators to design authentic learning experiences, while 2.6 states that it is necessary for educators to foster a culture of student ownership and model and nurture creativity. Approximately 25% of the HyperDoc artifacts required learners to publish or present new knowledge, aligning with ISTE Educator Standards 2.5 and 2.6. Strategies observed in the artifact analysis included in-class presentations, slideshow creation and Flip video discussions, empowering students to share newfound knowledge with peers and teachers, fostering a culture of knowledge sharing.

ISTE Standard 2.6 calls for educators to foster a culture of student ownership and model and nurture creativity. The analysis found that 45% of artifacts suggested an emphasis on learner autonomy, often demonstrated by choice boards and learning playlists. For example, a sixth-grade educator empowered students to explore science-related web resources through a Bitmoji classroom, fostering self-directed learning. In addition, a kindergarten teacher created a playlist in which students could select from a wide variety of videos, games and online activities to learn from in no required order. The choice and autonomy provided in these digital artifacts are clearly aligned to ISTE Standard 2.6.

Approximately 31% of the artifacts incorporated multimedia expressions, accommodating diverse learning preferences. Educators encouraged students to express ideas using multimedia applications, including mind maps, Google Jamboard, Flip video discussions, digital comic strips and interactive whiteboard activities. Examples included a kindergarten assignment for students to record safe stair-walking videos and use of Google Jamboard for story mapping in *Little Boo* by Stephen Wunderli. These multimodal opportunities were intended to enrich the learning experience and cater to diverse learning preferences.

Seventy percent of the analyzed HyperDocs required data collection and organization, aligning with ISTE Educator Standard 2.7. These methods ranged from traditional worksheets to interactive digital tools such as Google Jamboard and Google Forms, promoting not only learning objectives but also crucial data management skills among teachers.

ISTE Educator Standard 2.7 requires educators to understand and use data and assessment techniques to drive their instruction and support students in achieving their learning goals. Authentic assessment strategies aligned with ISTE Educator Standard 2.7 were evident in 28% of the HyperDocs analyzed. Examples included exit tickets, learning reflections and lesson-aligned artifacts. A sixth-grade English/Language Arts (ELA) educator had students complete journal entries for the *Bud, Not Buddy* HyperDoc exploring the Great Depression, while a fourth-grade ELA educator used a Venn diagram for comparing Eastern Woodland Tribes. However, some HyperDocs lacked embedded assessment techniques, indicating potential areas for future improvement.

### *Technology for English Language Learners training*

Along with participating in computer science modules and workshops on MacBook basics and blended learning, all educators engaged in a fully online training in technology for English language learners. As a final assignment in the training, all participants completed a reflection in which they documented two research-based strategies, digital tools and resources they implemented in the month following the training. All participants shared at least two strategies or digital resources. Many of the same themes were apparent in the reflection of technology employed over the month after the training. Of the strategies and resources shared, 70% were related to high quality web resources and 86% included resources that encouraged collaboration between the English language learner and their teacher/peers. These positive uses of technology were apparent from a variety of grades and positions.

For example, a first-grade teacher demonstrated using technology to promote collaboration with educators and peers (and parents) when she responded,

> I have created weekly videos on how to spell and pronounce sight words. I had my daughter pronounce the word, spell the word and use it in a sentence. This video was uploaded on Dojo (communication platform for parents) every Monday so students could review the sight words every day. At the end of the week students took a quiz to see how well they knew the sight words from the video. Creating a video for my students was extremely beneficial considering 95% of the parents only spoke Spanish and found it difficult to support their children in English.

Similarly, a middle-grades literacy interventionist wrote,

> I used Vocaroo a lot in my classroom. In classes of 25–35, it is hard to get spoken responses on a regular basis from students. Vocaroo is used to 'get students talking' in pairs or independently. Since they are recording, it is not in front of the class, which goes back to including a low-stress environment.

Demonstrating use of technology to create an authentic learning activity, (ISTE Standard 2.5.b) a fourth-grade science/social studies teacher reported,

> Google Earth was used during our "Save the Bay" unit. We started with a zoomed-in image of John Ruhrah and slowly zoomed out. Students noticed how close we were to the Inner Harbor and the Chesapeake Bay. We kept zooming out, which led to a discussion of the ocean into which the Chesapeake flows. We discussed fresh water flowing from the creeks, streams and rivers mixing with the salt water from the ocean creating the brackish water. Sci Show Kids and Crash Course Kids provided a wealth of information on a wide range of science topics presented at elementary level. When showing videos from these two sources, I often paused the videos. This was done to provide the students time to discuss what they saw. The speakers were also very quick speakers, so I think our ELLs benefitted from the pause and the extra time to process the information.

Also reflecting the promotion of authentic, relevant learner experiences, an eighth-grade math teacher stated,

> While working together with 8th grade EL math class to learn negative and positive slopes, we used Google Earth to grab pictures of pyramids from around the world. We added coordinate points to the picture and then students could visualize what a negative slope vs. a positive slope was. It also was handy when we were learning about the steepness of slopes.

The theme of promoting learner agency and choice was also prevalent in 60% of the responses. In commenting on the training, an English language arts teacher noted, "The video was very comprehensive! I used choice boards a lot in my classroom, which was very helpful." An occupational therapist wrote,

> Using YouTube to model hand strengthening warm-up tasks and using a video in the student's native language. I also used YouTube with closed captions when showing fine motor tasks in English to support literacy skills. I liked that I could stop the video and check for understanding. I could also model the tasks or provide support while the video continued to model the skills.

JREMS educators appeared to demonstrate a commitment to integrating technology to enhance learning, with notable strengths in connecting learners to quality web resources and promoting learner agency. These examples of anecdotal evidence demonstrate the value of technology integration for ELL students, leading to greater collaboration between ELLs, teachers, peers and parents.

*Computer science modules*

In keeping with ISTE Standard 2.5b, demonstrating use of technology to create an authentic learning activity, all computer science modules (coding, computational thinking, 3D design and circuitry) contained a final project assignment that required participants to create a lesson plan that integrated the new learning, teach the lesson and reflect on the experience. Reflections from computer science modules indicate that almost all teachers felt the courses contained the right amount of information to enable them to start using the materials and devices provided by the grant, know how to increase student interest in computer science, plan to modify curriculum in light of the training and plan to make use of the materials and activities in light of their training. Administrator observations indicated that these teacher reflections were being lived out, as there was a noted increase in computer science-based technology use in the classrooms. For example, in a reflection activity at the conclusion of a coding module, one of many positive responses was recorded from a JREMS teacher who wrote,

> I went from not knowing anything about coding to being able to code, only thanks to this . . . course. At the beginning of this course I had no confidence and now feel confident in teaching technology. I'm glad and feel fortunate that I participated.

## Discussion and conclusions

Educational technology has revolutionized the way learning takes place in today's classrooms (Dubé & Wen, 2022). In the current digital age, as the world embraces the fourth industrial revolution, technology is increasingly important in education for both teaching and learning (Henderson & Corry, 2021). This integration has allowed for a diverse set of technology-based tools to be used by educators, enhancing the learning process. The JREMS administration and NDMU PDS faculty recognized the need to innovate and develop learning platforms to support educators with technology content and pedagogical practices to enhance and innovate current curriculum. Together, the partners embraced interactive digital learning media to enable teachers to convey information and increase students' interest and motivation to learn.

Interactive digital learning tools were designed and implemented to facilitate teachers' knowledge transmission and enhance students' interest and enthusiasm toward learning. Moreover, classroom walkthrough data indicate that this technology integration has changed how teachers deliver information and students engage with and participate in learning. As one JREMS administrator noted,

> Through the implementation of grant funded courses and technology, JREMS has experienced a notable shift in how technology is utilized within the school. At the beginning of the year students were primarily passive recipients of instruction, watching their instructors teach from slide decks. By the end of the school year, it was noticeable that the staff had utilized coding, computational thinking, 3D design and electronics courses. Students were participating in online coding using Code.org, Art teachers were using 3D printers, students were programming with Makey Makeys and giving other students one-on-one directions to complete computational thinking activities. Through the successful implementation of the grant, JREMS faculty have been equipped with the necessary tools and knowledge to seamlessly integrate technology into their teaching methodologies. It is undeniable that the grant has effectively fulfilled its intended purpose.

The increase in comfort with technology, teaching with technology and use of activities using technology found in this study support the previous research of Teo (2009), Mouza *et al.* (2022) and Zeng *et al.* (2022). In their study, Teo (2009) found that "when users perceive a technology to be complex, they tend to find the technology less useful in that they would be unlikely to be productive and efficient by using it" (p. 309). This same finding was apparent in JREMS teachers' comfort with teaching using technology at the beginning of the study. The substantial increase in activities using technology during post observations of classes added support to research conducted by Mouza *et al.* (2022), which identified specific program design features that facilitated changes in teacher learning and practice also employed by this study, including hands-on activities, collaboration, reflection and ongoing support. This study further supports the research of Zeng *et al.* (2022), whose overall findings were in favor of a positive relationship between teachers' technology integration self-efficacy and their pedagogical knowledge surrounding the use of technology.

*Originality/value*

The outcomes of significant positive changes in educator efficacy, comfort with technology along with an increased integration of technology, is a clear example of the benefit of a PDS partnership. This initiative was original in its approach to teacher development by providing teacher professional development with an invitation to participate and a reward for participation (a personal MacBook) that met the stated needs of teachers. Teacher motivation was high as teammates in a PDS partnership provided the necessary supports to induce positive changes in attitudes, anxiety and self-efficacy (Corry & Stella, 2018; Henderson & Corry, 2021; Teo, 2009).

*Implications*

This study highlighted the benefits of a strong PDS partnership in changing teacher self-efficacy in technology use. Given the framework of self-efficacy presented by Bandura (1997), it is apparent that educators were able to see how certain actions (i.e., learning new technology and its integration into the curriculum) were able to produce positive outcomes in their classroom, as well as feelings of confidence in their skills to use the technology effectively.

In light of the high percentage of ELLs at JREMS, providing teachers with various tools to create stronger hands-on and challenging learning experiences has been of great benefit. Key elements of teacher design that facilitate change in teacher learning and practice in technology (Mouza *et al.*, 2022) were richly demonstrated in this project. They included professional development, practice, collaboration and reflection activities which were woven into modules on blended learning, technology and specific online teaching tools for ELLs.

*Recommendations for future research*

The NDMU/JREMS partnership will continue to build on the enthusiasm through continued classroom monitoring and support from JREMS administration, along with highlighting great classroom technology use during scheduled professional developments and faculty meetings throughout the next year. NDMU faculty will continue to support JREMS faculty and staff through in-person one-on-one mentoring and online workshops through the NDMU global classroom. The large percentage of ELLs at JREMS will be impacted by the increased differentiated and hands-on technology approach embedded in instruction and the additional implementation of vocabulary support through technology tools implemented by all teachers.

In a replication of this study, it is recommended that the pre- and post-measurement of teacher use of technology in the classroom capture more details about differences in ways technology is used, as well as qualitative information regarding challenging aspects of use. Additionally, this research was limited to just one year. A longer study that gathers data on follow-up support over time and corresponding changes in application of technology in instruction is suggested.

With the creation of the computer science and technology trainings and modules, it would be beneficial to extend this opportunity to other PDS partnerships in need of this support. Applying lessons learned in first building teacher motivation, a second PDS partnership with a high ELL population, Johnnycake Elementary, is currently surveying teachers to gauge their interest in professional development focused on technology integration through the PDS partnership. More broadly, all PDS partnerships would benefit from this example of building computer science instruction and technology integration through collaboration. Universities supply the grant-writing capabilities, infrastructure to manage grants and the expertise of faculty. K-12 schools supply the teachers and applied opportunities for research and collaboration for the benefit of K-12 students.

## Note

1. A PDS site-coordinator is the "designated representative for the school principal and will lead the charge of implementing the PDS on behalf of the school administration" (Savick, 2023). The PDS liaison is "the contact person representing the university (Savick, 2023).

## References


21st Century Schools: Baltimore (2023). About, Baltimore City public schools. Available from: Available from: https://baltimore21stcenturyschools.org/about

Baltimore City Public Schools. (2023). Datalink. Available from: https://www.baltimorecityschools.org/staff-member.

Bandura, A. (1997). *Self-efficacy in changing societies*. Cambridge University Press.

Bugler, D., Marple, S., Burr, E., Chen-Gaddini, M., & Finkelstein, N. (2017). *How teachers judge the quality of instructional materials*. San Francisco, CA: WestEd.

Corry, M., & Stella, J. (2018). Teacher self-efficacy in online education: A review of the literature. *Research in Learning Technology*, *26*, 1–12. doi:10.25304/rlt.v26.2047.

Darling-Hammond, L., Hyler, M., Gardner, M., & Espinoza, D. (2017). *Effective professional development*. Learning Policy Institute. Available from: https://files.eric.ed.gov/fulltext/ED606741.pdf

Dupuis, J., Pallett, L., & Bull, K. B. (2023). 'Just in time': Meeting the diverse needs of today's teacher candidates. In S. Helfrich, & S. Hartman (Eds.), *Exemplary Clinical Models of Teacher Education*. Information Age Publishing.

Dubé, A. K., & Wen, R. (2022). Identification and evaluation of technology trends in K-12 education from 2011 to 2021. *Education and Information Technologies*, *27*, 1929–1958. doi: 10.1007/s10639-021-10689-8.

Garrison, F. H. (1935). memoriam: Dr. John Ruhrah (1872-1935). *Bulletin of the Institute of the History of Medicine*, *3*(5), 400–402. Available from: https://www.jstor.org/stable/44438010

Henderson, J., & Corry, M. (2021). Teacher anxiety and technology change: A review of the literature. *Technology, Pedagogy and Education*, *30*(4), 573–587. doi:10.1080/1475939X.2021.1931426.

Highfill, L., Hilton, K., & Landis, S. (2016). *The Hyperdoc handbook: Digital lesson design using Google Apps*. Elevate Books EDU.

Huang, B., Jong, M., Tu, Y., Hwang, G., Chai, C., & Jiang, M. (2022). Trends and exemplary practices of STEM teacher professional development programs in K-12 contexts: A systematic review of empirical studies. *Computers & Education*, *189*. doi: 10.1016/j.compedu.2022.104577.

ISTE (2023). ISTE Standards: For educators. Available from: https://iste.org/standards/educators

Laal, M., & Ghodsi, S.M. (2012). Benefits of collaborative learning. *Procedia - Social and Behavioral Sciences*, *31*, 486–490. doi: 10.1016/j.sbspro.2011.12.091.

Marshall, D. T., Pressley, T., & Love, S. M. (2022). The times they are a-changin': Teaching and learning beyond COVID - 19. *Journal of Educational Change*, *23*(4), 549–557. doi:10.1007/s10833-022-09469-z.

Mouza, C., Codding, D., & Pollock, L. (2022). Investigating the impact of research-based professional development on teacher learning and classroom practice in computer science education. *Computers & Education*, *186*, 1–16. doi: 10.1016/j.compedu.2022.104530.

National Association for Professional Development Schools (NAPDS) (2021). What it means to be a professional development school: The nine essentials, (2nd ed.) [Policy statement]. Available from: https://napds.org/nine-essentials/

Notre Dame of Maryland University (2023). Mission and social responsibility. Available from: https://www.ndm.edu/about-us/mission-social-responsibility

Oakes, J., Maier, A., & Daniel, J. (2017). *Community schools: An evidence-based strategy for equitable school improvement*. National Education Policy Center. Available from: https://learningpolicyinstitute.org/sites/default/files/productfiles/Community_Schools_Evidence_Based_Strategy_BRIEF.pdf

Sablić, M., Šimić, I., & Knežević, I. (2020). Video-Based Learning (VBL)—past, present and future: An overview of the research published from 2008 to 2019. *Technology, Knowledge and Learning*, *26*, 1061-1077. doi: 10.1007/s10758-020-09455-5.

Savick, W. (2023). *Notre Dame of Maryland University PDS partnerships site coordinator and liaison handbook*. Department of Education, Notre Dame of Maryland University. Available from: https://sites.google.com/view/ndmupds/site-coordinators-liaisons

Savick, S., Durham, R. E., Silver, P., Letizia, A., & Watson, M. (2022). Professional development and community school models meet to make a difference. In J. Ferrara, J. Nath, & R. Beebe (Eds.), *PDS and Community Schools*. (pp. 191–217). Information Age Publishing.

Schwarzhaupt, R., Wilson, J., Lee, F., & Raspberry, M. (2021). Teachers' engagement and self-efficacy in a PK–12 computer science teacher virtual community of practice. *Journal of Computer Science Integration*, *4*(1), 1–14. doi: 10.26716/jcsi.2021.10.8.34.

Teo, T. (2009). Modeling technology acceptance in education: A study of pre-service teachers. *Computers & Education*, *52*(2), 302–312. doi: 10.1016/j.compedu.2008.08.006.

Thompson, A. D., & Mishra, P. (2007). Breaking news: TPCK becomes TPACK!. *Journal of Computing in Teacher Education*, *24*, 38–64. doi: 10.1080/10402454.2007.10784583.

Weng, X., Ng, O., & Chiu, T. (2023). Competency development of pre-service teachers during video-based learning: A systematic literature review and meta-analysis. *Computers and Education*, *199*. doi:10.1016/j.compedu.2023.104790.

Zeng, Y., Wang, Y., & Li, S. (2022). The relationship between teachers' information technology integration self-efficacy and TPACK: A meta-analysis. *Frontiers in Psychology*, *13*. doi:10.3389/fpsyg.2022.1091017.

## Appendix

### Technology Integration Self Efficacy Survey Instrument (Pre/Post)*

The following questions have no correct or incorrect answers, so please select your level of agreement based on how you feel today:

Response Scale.

1 = strongly disagree, 2 = disagree, 3 = neither agree or disagree, 4 = agree, 5 = strongly agree.

Comfort with Technology.

1. If I come across a technological problem, I tend to give up easily.
2. I will probably never be good with technology.

3. I think my computer skills will never surpass basic knowledge.
4. The idea that, in the future, schools will be more strongly influenced by technology makes me anxious.

*Teaching with Technology*

5. I feel confident that I can create meaningful learning experiences for my students using technology.
6. I understand technology well enough to be effective in teaching my students to use it, too.
7. When a student has difficulty with their device, I feel confident that I will know how to help them with the problem.
8. When teaching English language learners, I feel confident about ways to integrate technology.
9. I can integrate technology into my current curriculum.
10. I know where to find resources to use technology when planning instruction.
11. I can create learning activities that use technology at the appropriate level for my students.

*Adapted from an instrument developed by Computer Science for All Teachers (Schwarzhaupt *et al.*, 2021).

**Corresponding author**
Patrice Silver can be contacted at: psilver@ndm.edu