The Use of One-to-One Devices in an Urban School District

Barbara Lewis McCarthy
Seton Hall University

David B. Reid
Seton Hall University

This study analyzed data from a survey distributed to teachers in an urban school district in New Jersey. The survey asked teachers about their past and current perceptions of, and practices with, the use of classroom technology and in particular one-to-one devices. Findings reveal teachers generally perceive technology as positive in teaching and learning, but also noted some limitations. The biggest takeaway from this study is that teachers believe they can improve both their technology skills and their methods of technology integration into instruction, provided they are given the necessary time to learn, use, and practice with technology and one-to-one devices.

Keywords: classroom technology, one-to-one devices, teacher beliefs

The concept of each child having a laptop or tablet for their own use at school is commonly referred to as a one-to-one device program – one device for one student. Ideally, students have full use of a device for the entire school year (Education Reform, 2013). However, many urban minority school districts have not been able to enact such a program due to lack of funding. Prior to the COVID-19 pandemic shutdown of schools, two-thirds of classes in the district under study, from here on referred to as *NJ Urban,* did not have a one-to-one device program. However, when schools shut down in March 2020, districts which did not yet have a one-to-one device program rushed to supply their students with one-to-one devices so they could learn from home, with demand increasing so much that there were shortages in supply (Rauf, 2020). For example, the state of New Jersey received over $310,000,000 through the Federal Government's CARES Act for pandemic-related relief, which included $200,000,000 in Elementary and Secondary School Emergency Relief Funds (ESSR). Of this, over $33 million went to the school district under study, NJ Urban, some of which was used for purchasing one-to-one devices so that students had access to online classes and could communicate with their teachers from home (NJ.com, 2020).

As there has never been a situation before where all teaching was forced to be done remotely, this study did not follow a specific theoretical framework, but was instead a grounded-theory effort to gather information on the use of technology by teachers following a period of enforced remote teaching.

Purpose

The purpose of this study was to gather the perceptions of teachers who taught remotely during the 2020-21 shutdown of schools, and who returned to teaching in-person classes, to see if and how their classroom instructional practices regarding the use of technology and one-to-one devices changed after a year of teaching remotely. With schooling back to pre-pandemic operations, this study was designed to explore what, if anything, changed in the way teachers utilize technology and, in particular one-to-one devices, in their instructional practice. This study surveyed all teachers in the NJ Urban school district to gather their perceptions of the use of classroom technology, in particular one-to-one devices. Of the 754 teachers surveyed, 394 (52.24%) responded by completing the survey.

The research questions that guided this work were: (1) What are teachers' perceptions of the use of technology in the classroom?; (2) In what ways have classroom teachers changed their instructional practices after a year of remote teaching?; and (3) In what ways are classroom teachers now leveraging a one-to-one device program for their instruction?

Review of Literature

This review of literature has been subdivided into five sections to aid in understanding: Technology in schools; Teachers' perceptions of technology in the classroom; Sustaining effects of technology use; Students and one-to-one devices; and a final section on current gaps in the literature.

Technology in Schools

Technology and personal computers have progressed in leaps and bounds in recent years, and according to the American Community Survey, 92% of households in the United States had a smartphone or laptop in 2018, and 85% had Internet access (Martin, 2021). Schools have expanded their technology programs, increased their Internet bandwidth and many have provided their students with a one-to-one device; an iPad, laptop, or Chromebook-that they may use in class and take home with them after school. Despite this progress, there are many studies which show that technology is not being fully integrated into teachers' lesson plans, and that in fact, much of the available technology sits idle in the classroom for most of the day (Herold & Smith, 2015; Li, 2007). Much has been made of this, and both school districts

and technology corporations have pushed to find out why there is this seeming reluctance by teachers to use available technology, and what can be done to increase the likelihood of teachers integrating technology into their daily lessons (Cuban et al., 2001; Hsu, 2016; Li, 2007). Larry Cuban, one of the first to focus research on classroom technology, referred to the integration of technology in education as a "slow revolution" and posited that leaving teachers out of the decisions as to what type of technology to buy/use in schools was partly to blame for them being underused in classrooms (Cuban, 2001). He, and others (Ames, 2019; Herold & Smith, 2015; Reich, 2021), suggested that baby steps in adding technology to classrooms will be more successful in the long run than the rapid overhaul proposed by politicians and corporate interests, and that if teachers were allowed to choose the technology that fit their needs, instead of having it imposed on them, they would be more likely to use it more often (Vu et al., 2019). However, as Herold suggests, with the numerous demands on teachers' time already, integrating more technology may be up against some resistance as "totally changing the way you do your job takes a ton of time and work" (Herold, 2015, p. 7). These views combined are likely close to the truth: if the teachers do not get to choose the technology they want, and do not think it will improve their lessons, they are unlikely to want to put in the needed time to integrate it into their classes (Li, 2007; Ottenbreit-Leftwich et al., 2010).

Teachers' Perceptions of Technology in the Classroom

Prior to the COVID-19 pandemic shutdown of schools, teachers had little to no experience of teaching remotely (Trust & Whalen, 2021). Switching to remote learning meant that teachers had to modify their lesson plans and find sources that were available online to help their students, rather than using the classroom or school libraries to which they would normally have turned (Green et al., 2020). It also meant that teachers had to find a support network other than their usual group of colleagues or personal learning network (PLN) they would turn to when schools were in-person. Many of them turned to social media support/learning groups, or to using YouTube videos, to learn how to use and/or integrate technology into their lessons (Trust & Whalen, 2021).

Prior research findings have shown that some teachers are not comfortable themselves with the advances in technology, and so are reluctant to use it in class, in case something goes wrong, and they are unable to fix it (Cuban et al., 2001; Li, 2007; Taimur et al., 2021). Many, particularly older teachers, still adhere to the sage-on-the-stage approach to teaching, and do not wish to risk being embarrassed, or feeling incompetent, if they are unable to figure out any mishaps with the technology (Blau et al., 2014; Hsu, 2016; Lieberman, 2020). Younger teachers who have grown up with technology are reportedly more likely to use it in class, but even among them, it is frequently just used for skills and drills, typing up projects or papers, or for watching videos (Ertmer & Ottenbreit-Leftwich, 2010; Schleicher, 2020).

To keep up with the new developments, teachers need to spend time learning and practicing with new applications. In fact, studies have shown that in order for teachers to be fully comfortable with using a new application, they need to spend 40 hours or more using it themselves, before being able to effectively integrate it into their classes (Hammond, 2017). Finding time to practice a new application is very difficult for teachers, with all the other demands on their time, but time to practice is vital in order for teachers to be able to skillfully integrate new technology into their lessons (Kopcha, 2012).

Sustaining Effects of Technology Use

According to Ertmer (1999), there are two types of barriers to increasing technology use among teachers. The first is external to teachers and refers to the availability of appropriate equipment and training for teachers to know how to use the technology. This is what Ertmer refers to as "first order barriers." The second barrier is internal and refers to factors such as internal beliefs, attitudes, confidence, and skills. This she refers to as "second order barriers." The pivot to remote learning essentially removed many of

the first order barriers. The question now is: did the time of using exclusively technology to teach help to remove the second order barriers, and if so, will this effect be sustainable over the long term?

Although it is too early to tell if any changes will continue to influence teachers over the long term, there have been previous studies which showed that an intense period of concentrated learning in reading and/or English language skills can result in sustained gains even after the intense learning period has ended (Anderson, & Stonehill, 1982; Escamilla et al., 1998). These gains continued to be steady even two or three years afterwards. A recent study in Ireland by Winter et al (2021), which looked at technology use among teachers during the pandemic, came to the conclusion that the time teachers have spent using technology exclusively has increased their confidence levels, and may perhaps reduce some of the second order barriers referred to by Ertmer (1999), but that it is really too early to tell if these effects will persist over the long term (Winter et al., 2021).

The vast majority of research on remote or distant learning has been done with adult populations, and these have limited relevance to the pandemic situation as "children have fundamentally different learning needs to adults" (Starkey et al., 2021, p. 43). Some articles have come out recently (after the shutdown), that report on the difficulties of the pivot to remote learning and on the problems teachers and students had coping with the switch. While many assumed that students would adapt well to remote learning, as they spend so much time on their devices, teachers actually found that students struggled. As an article in the Wall Street Journal noted, being a *digital consumer* is a lot different from being a *digital learner*, and the switch is not always intuitive (Hobbs & Hawkins, 2020).

Many teachers also struggled with deciding how best to integrate technology into their lessons, in order to engage their students as much as possible. Although teachers had professional development to show them how to use various technologies, they were unsure of the best or most appropriate ways to integrate them into their lessons (Hutchison & Reinking, 2011; Thoma et al., 2017).

Students and One-to-One Devices

Prior research has indicated that students' engagement, as well as their reading and math skills improve when schools have a one-to-one program (Genota, 2018; Islam & Grönlund, 2016; Zheng et al., 2016). However, there have also been studies that indicate reluctance on the part of teachers to utilize said one-to-one programs to their greatest potential (Cuban et al., 2001; Ertmer, 1999; Luo & Murray, 2018). Teachers, administration, and technology corporations all have suggestions for how to use one-to-one devices in schools. The general purpose of one-to-one devices is "to enhance learning in general as well as more specifically contribute to development of 'twenty-first century skills' such as creativity, critical thinking and communication skills" (Islam & Ke Grönlund, 2016, p. 192). Research has shown that with one-to-one devices, teachers are able to more easily provide individualized help to students using computers, which is particularly effective with reading skills, as teachers are able to scaffold learning according to students' needs, and to provide students access to online dictionaries, or text-to-speech programs which they can use to expand their background knowledge (Zheng et al., 2016).

The use of one-to-one devices has been found to improve students' academic scores, particularly in math, and mainly due to the ability to personalize learning, with programs such as Freckle, IXL, and GoMath, which track students' progress and match future assignments to their current level (Genota, 2018). A meta-analysis in 2016 found that students' performance improved in writing and science, in addition to mathematics, for schools with a one-to-one device program. However, there was no statistically significant improvement in reading (Zheng et al., 2016), and in fact, there is some evidence that free reading by students decreases when they are given a one-to-one device (Hull & Duch, 2019).

Gaps in the Literature

Given the financial investment in New Jersey supplying students with one-to-one devices, it is important to know how these devices are now being used, so that school districts can decide if they want to continue with a one-to-one program or if they want to phase it out. There are costs involved in running one-to-one programs, as all devices must be properly maintained and updated, and replaced if broken or damaged. In addition, support staff are needed to provide training and support to both teachers and students, and to ensure devices and security systems are running properly (Machusky & Herbert-Berger, 2022). Technology is advancing at such a rate that these devices will likely need to be replaced within 5 years at most, so continuing a one-to-one program is a large investment for a school district. The data gathered in this study may help the school district in question to decide on the future of its one-to-one program.

Method

Context and Sample

The school district for this study, NJ Urban, has twenty schools and a population that is almost 100% minority students. The district is in a high-poverty area, with a poverty rate (prior to the COVID-19 pandemic) of 19.1%, meaning that one out of every 5.2 people in the district lives in poverty. This is substantially higher than the overall poverty rate in New Jersey of 10.7%. The use of one-to-one devices in schools dates back to the 1990s, and although many districts had one-to-one programs prior to the COVID-19 pandemic, the district under study, NJ Urban, did not have such a program in place.

Prior to the pandemic, most teachers in the district had an Apple PC for their use in the classroom. Many of the classrooms also had a promethean or smart board. On average, there were 3-6 laptop devices in each classroom for student use. The district primarily used the Google suite of applications for education, although they did have some other district-provided applications for use as needed from Pre-K 3 through 12th grade, principally for reading, math, and science. The majority of schools had at least one laptop cart – larger schools had one on each floor – which could be checked out by teachers on an as-needed basis. They did not have one device for each student, so students had to share devices with one or two other students.

As such, this district appeared to be an ideal one to study, to see how teachers perceived the intense period of technology use during the 2020 shutdown of schools, and how the newly acquired one-to-one devices may have changed the way they instruct their classes since the return to in-person learning.

The population for this survey research was classroom teachers in the NJ Urban school district. The sample was limited to the 754 teachers currently employed (in May 2022), and who began teaching in the district prior to March 2020, so that they had experience teaching prior to, during, and after the COVID-19 pandemic shutdown of schools. Table 1 shows a breakdown of the demographics of those who participated in the study.

Table 1

Participant Demographics:

Gender	Female	Male	Prefer not to say			
	74% (153)	22% (45)	4% (9)			
Race	Asian	Black/AA	Pac. Island	White	Other	Prefer not to say
	0.5%	51%	0.5%	30%	7%	11%

	(1)	(104)	(1)	(61)	(15)	(23)	
Hispanic	Yes	No	Prefer not to say				
	11% (23)	79% (162)	10% (21)				
Age	18-24	25-34	35-44	45-54	55-64	65+	Prefer not to say
	0.48% (1)	12.98% (27)	31.25% (65)	29.81% (62)	17.31% (36)	1.92% (4)	6.25% (13)
Education	Associate Degree	Bachelor's Degree	Master's Degree	Doctoral Degree	Prefer not to say		
	1% (3)	17% (35)	72% (149)	6% (12)	4% (8)		
Length of time in district	0-2 years	2-5 years	6-10 years	11-15 years	16+ years		
	6% (13)	16.74% (36)	14.42% (31)	15.35% (33)	47.44% (102)		

Note: not all participants answered demographic questions

Survey

The survey was an original instrument, informed in part by the LoTI Digital Age Survey for Teachers, distributed by the International Society for Technology in Education (ISTE). Using descriptive statistics and open-ended survey questions and interviews, information was requested on the perceptions of classroom teachers regarding the use of technology, particularly one-to-one devices, in their instructional lessons. Specifically, the purpose of this study was to gather the perceptions of teachers who taught remotely during the 2020-21 shutdown of schools, and who returned to teaching in-person classes, to see if and how their classroom instructional practices regarding the use of technology and one-to-one devices changed after a year of teaching remotely. Prior to distribution, the survey was reviewed by a committee of experts in the field, and then piloted in a similar urban school district, adjacent to the one under study. Twelve teachers completed the survey during the pilot study and were additionally asked to comment on its format and whether they thought anything needed to be added or changed. Following this, some of the questions were modified slightly to improve clarity. The survey questions asked teachers a variety of questions to gather information on how exactly they used technology in the classroom (Appendix A). This survey was administered in May and June of 2022.

Note: Although there are many mentions of the COVID-19 pandemic and the subsequent shutdown of schools in the teachers' responses, COVID-19 itself was not a subject of this study. It was purely a matter of convenience, as the shutdown of 2020-21 led to the rapid deployment of one-to-one devices in the district, and also to a time of teachers using only technology for instruction**.**

Analysis

Data from the survey responses were exported from Qualtrics to Excel. Qualitative data were uploaded to ATLASti. The original data were saved, and a copy was used for cleaning the data and subsequent

analysis, so that the original data would be available for reference at a later date if necessary. All responses were de-identified and randomly issued with a Case number, which was then used to identify all quotations. Excel was used to analyze the quantitative data and to create graphs to portray that data. The qualitative data were uploaded to ATLASti and coded using inductive coding, to group common responses and to identify trends among the open-ended comments.

Establishing Credibility

To check for reliability and validity, the proposed survey was reviewed by my dissertation committee. Following their input, and after some suggested alterations were made, the survey was piloted in a second similar urban school district, adjacent to the one under study. Respondents were asked to provide comments on the pilot survey once they had completed it. These comments and suggestions were considered, and some modifications were made prior to the final survey being administered.

Following administration of the survey, teachers from two of the twenty NJ Urban schools who had responded to the survey were contacted and asked for their opinion of the survey, and if they thought it had covered everything relevant to the use of school technology in NJ Urban school district. All those who responded indicated that they thought the survey covered everything, and that it was clear and easy to follow. One teacher commented that the survey took a little longer than the estimated 30 minutes for him to complete; the others indicated that they completed the survey in 30 minutes or less.

Limitations

Potential obstacles for online surveys include response rate, which is traditionally rather low for survey research (Fan & Yan, 2010; Wu et al., 2022). To combat this, reminders were sent to all members of the sample whose responses were incomplete at one, two, and three weeks after the initial mailing.

Asking teachers to recall their classroom technology activities prior to the Covid-19 shutdown of schools may result in inaccurate remembering.

Despite assurances that all data collected will be confidential, there is always the risk that respondents will answer with what they think they should be doing, rather than that which they are actually doing.

This study looked at one urban minority school district in New Jersey, and as such, may not be generalizable to other school districts with dissimilar populations.

Findings

The purpose of this study was to gather the perceptions of teachers who taught remotely during the 2020-21 shutdown of schools, and who returned to teaching in-person classes, to see if and how their classroom instructional practices regarding the use of technology and one-to-one devices changed after a year of teaching remotely. Three research questions guided this research: (1) What are teachers' perceptions of the use of technology in the classroom?; (2) In what ways have classroom teachers changed their instructional practices after a year of remote teaching?; and (3) In what ways are classroom teachers now leveraging a one-to-one device program for their instruction?

Teachers' perceptions of the use of technology in the classroom

Returning to in-person teaching following the period of remote instruction during the shutdown, teachers in the NJ Urban school district are overwhelmingly more comfortable using technology now (Figure 1). Of the 214 teachers who responded to the question on comfort level with technology, just five said they felt

less comfortable now, 64 said that they felt about the same level of comfort, and 145 said that they felt more comfortable using technology now than they had prior to the pandemic shutdown. Teachers' perceptions of classroom technology were overwhelmingly favorable.

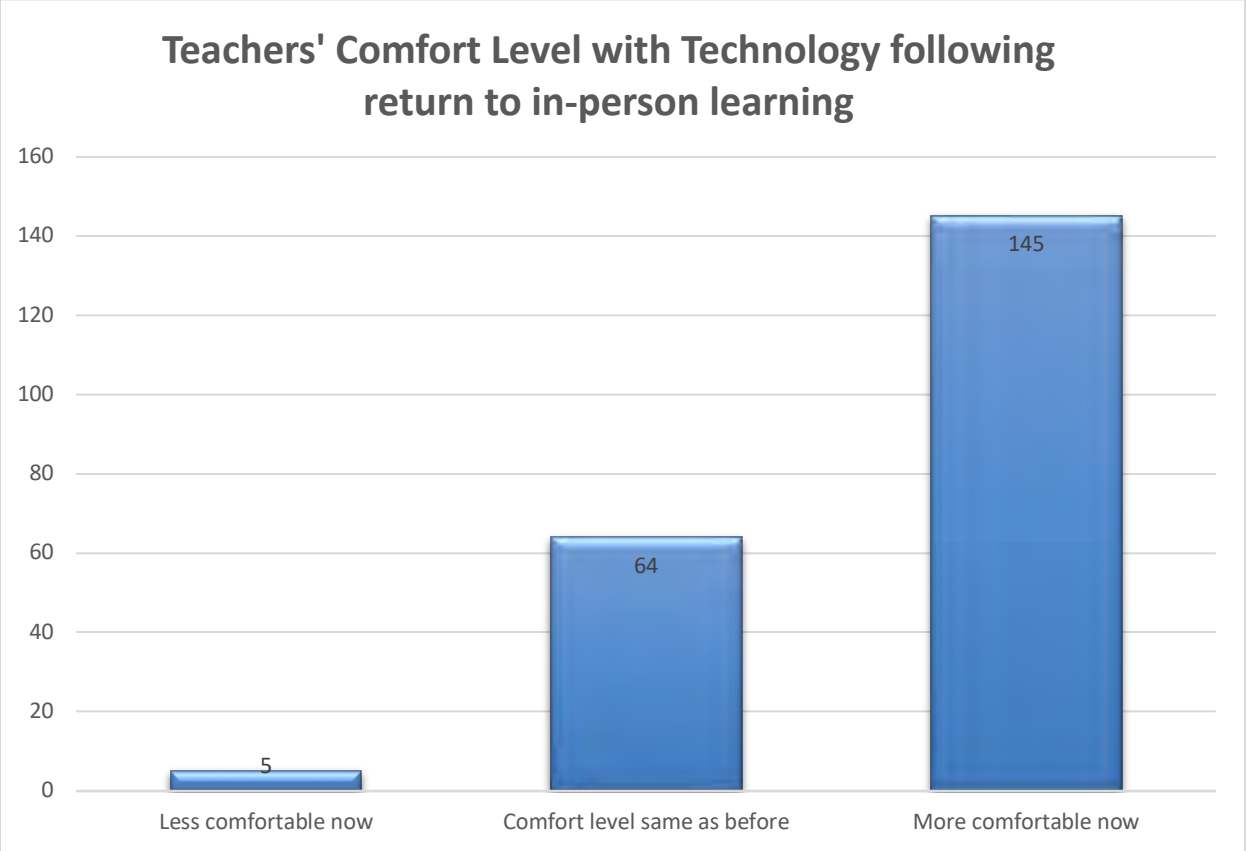
Analysis of the qualitative data revealed two main themes in response to the first research question: (1) teachers' perceived technology positively impacted student learning, but there were limits to what technology could do; and (2) teachers believed they needed increased training and support to best use technology – and specifically one-to-one devices – in the classroom.

First, teachers like the way technology can be tailored to meet individual student's needs, and that they can easily monitor how each student is doing. For example, Case 187 said, "I can track what they are doing better, via google docs for example". The teachers perceive that using technology in the classroom enables them to tailor their lessons to individual student's abilities and gives them the means to easily track and monitor their students' progress.

While some teachers indicated they now use technology as their primary means of instruction, the majority use it for practicing math and reading skills, with two-thirds of them using one-to-one devices every day. Teachers perceive that using more technology in class actually saves them time, as lessons can be stored online and easily modified for use in the future, and many of the applications they use can automatically grade students' work which means the teachers don't have to use their own time to grade work.

Figure 1

Teachers' comfort level with technology following return to in-person learning.



Teachers also perceive that one-to-one devices are a convenient way to help those students who may be struggling in the areas of math and reading to upgrade their skills by practicing the concepts that

they find challenging.

One way teachers perceive technology keeps students engaged is by reaching students at their current level, modifying options depending on the students' performance, and helping to reinforce prior learning. According to Case 46,

> Technology makes it easier for all my students to access the same content and allows for me to present concepts in multiple representation. It allows students to be staggered in their learning, which helps push the advanced students, while assisting those that have more needs.

Despite these positive perceptions, teachers were also wary of relying too much on technology during instruction. For example, Case 17 commented,

> We have to be careful that we aren't just sitting them at a desk with a device and just letting the "platform" do the teaching without any guidance from the teacher. There still needs to be interaction between student and teacher.

Good pedagogy is still a necessity and students still need direction and encouragement as they use their one-to-one devices. It is not enough to just assign a topic and tell the students to find the answers for themselves. Case 15 worried that that was already happening at her school:

> Some teachers are using technology as a crutch. They are just assigning activities on the computers and not really teaching the skill before assigning. They're letting the programs teach the kids. This is a great loss for those particular students.

While the overwhelming perception of technology seemed to be positive, a number of teachers felt that there was now too much reliance on technology and consequently students' competencies in basic skills, such as handwriting and math, were being negatively affected. Furthermore, teachers recognized that students with devices need to be monitored carefully, as there is always the temptation to switch to another tab to something more entertaining, or to try to multitask by working with multiple tabs at the same time. Case 8 commented, "One-to-one device use is only helpful if the students are using the equipment appropriately and staying on sites the teacher assigns. So, classroom management is a big part of the one-to-one classroom device use". This sentiment was reiterated by Case 63 who wrote, "one-to one technology allows for increased student engagement within classrooms as well as more easily differentiated instruction, however it also opens the door to more distractions [games, videos, cameras, etc.]." In a similar vein, Case 187 also thought that the students needed closer monitoring: "students' independence with technology has kind of made them go more on games than on academic/learning programs." Case 44 thought that the usefulness of one-to-one devices depended on the students using them: "Students need to be internally motivated. Otherwise, laptops are a distraction on par with cell phones."

Changes to Teachers' Pedagogy

Examining responses with regard to the second research question, three themes became evident. First, teachers' experiences working remotely have helped them to develop a confidence and fluency with technology that they did not have before. Case 116 noted "I feel I'm way more fluent in my technology use as it was my sole means of communicating with students in 2020." In another example, Case 76 said, "I am familiar with more online programs…I feel more confident in my online instruction strategies." This increase in confidence and fluency with technology means that the teachers are now more willing to change their instructional methods by adding more technology into their lesson plans. Case 139 commented,

> Because of the pandemic I had to teach differently, and I wanted to feel confident just like in the classroom to maximize student learning. In addition to planning my lesson plans, I learned how to create google slides and put links and teaching materials in them

> prior to lessons to keep the students engaged without interruption... I also found (bought) slides that I could use via share screen to have the students interact with the lesson.

Prior to the pandemic the majority of teachers said they used technology sparingly in their instructional lessons, but now the majority of teachers say they use it daily. When asked why their instructional methods had changed, most teachers mentioned that it was due to the time when they were forced to use technology during the shutdown. Teachers are now more fluent in technology and therefore more confident and savvy using technology in the classroom. As Case 104 put it, "I know more computer programs. I can navigate various internet platforms that I wasn't familiar with prior to September 2021." Similarly, Case 152 said, "I have more knowledge and have become a certified google educator. I use many different platforms and resources because I have had more training of technology-based curriculum."

The second theme that emerged was that teachers are taking advantage of technology to differentiate their lessons, so that they can reach all of their students. They are now familiar with more applications and programs and have realized they can be used to enhance their lessons and help engage students who may otherwise be unengaged. Case 80 summed up her experiences, writing:

> I upload instructional support videos and resources to help them when they are behind or stuck. This helps me differentiate teaching and students are more independent learners. I observe the learning needs and create instructional videos to support students. That way they are not sitting and waiting for help while I am assisting another student or teaching a small group.

Teachers have also realized that they can use technology as a means for students to help themselves: "Students can use tech for extra help using a variety of math/reading applications students can simply use by themselves" (Case 4). This in turn helps teachers as they try to group their students according to ability.

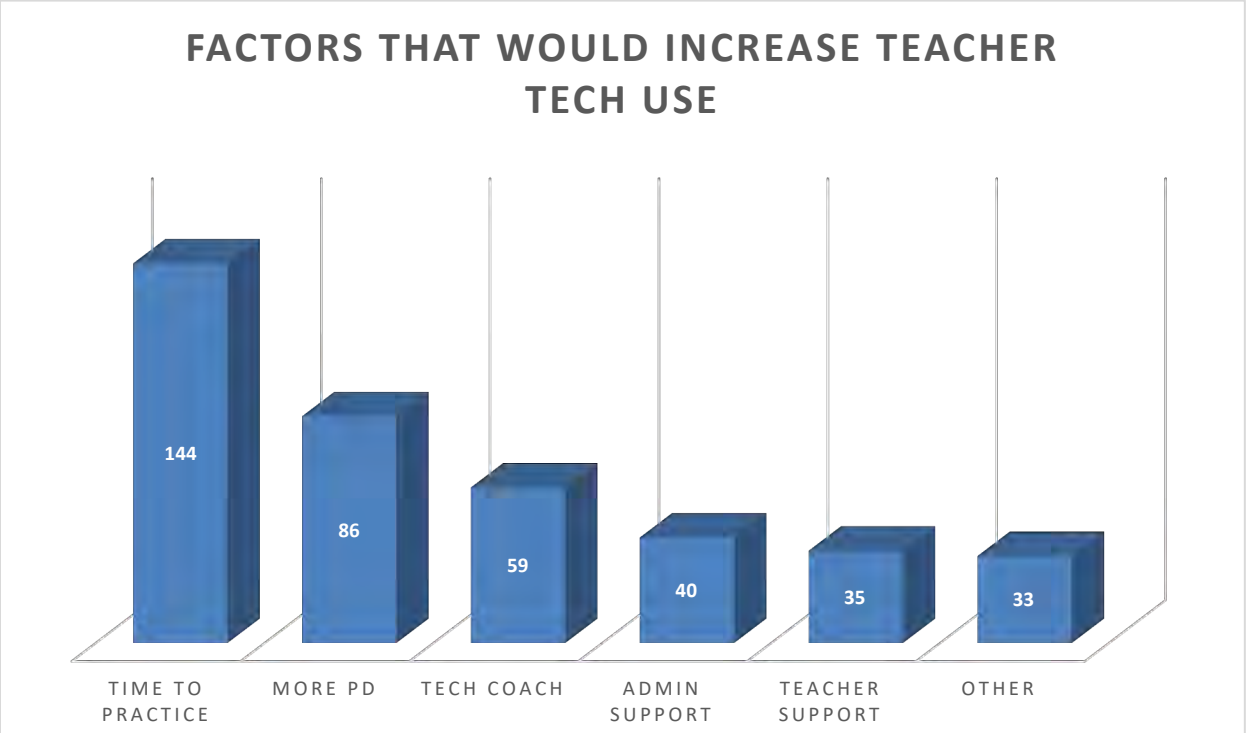
Using more technology "helps teachers collect data to help drive their small group instruction and interventions to close those learning gaps" (Case 165). Case 116 added that technology:

> …allows teachers to differentiate instruction, especially for students who are struggling 2-3 grade levels below because you can assign online activities on their grade level in which they can practice on a daily basis in small group. When the teacher doesn't have time to meet with them in small group or one-to-one, the student will be able to continue to play videos of content and practice content related skills.

In sum, teachers are more comfortable with and more inclined to use technology in their lessons post-COVID, since they have had the time, during the period of remote learning, to familiarize themselves with different applications and programs, and to take advantage of online professional development. This has contributed to increased comfort with using technology during their classroom instruction and that has led them to change their instructional practices by including more technology in their lessons: "I have found more creative ways to engage all learners at their individual levels" (Case 102). As one teacher put it, she now has "a bigger toolbox of ideas" (Case 150).

Being familiar with how the programs work has given teachers more confidence in using them in the classroom. Teachers also mentioned they would use technology even more if they had more time to practice, and if increased supports were available (Figure 2). Having students who are more familiar with the technology means that there are less delays and/or disruptions to the class when the teacher assigns something on the computer, so teachers are willing to include more technology in their lessons now than they did prior to the shutdown: "Students have become more tech savvy and it is more convenient to go paperless." (Case 132).

Figure 2
Factors that would increase teachers' use of classroom technology.



How Teachers Leverage One-to-One Devices in their Instruction

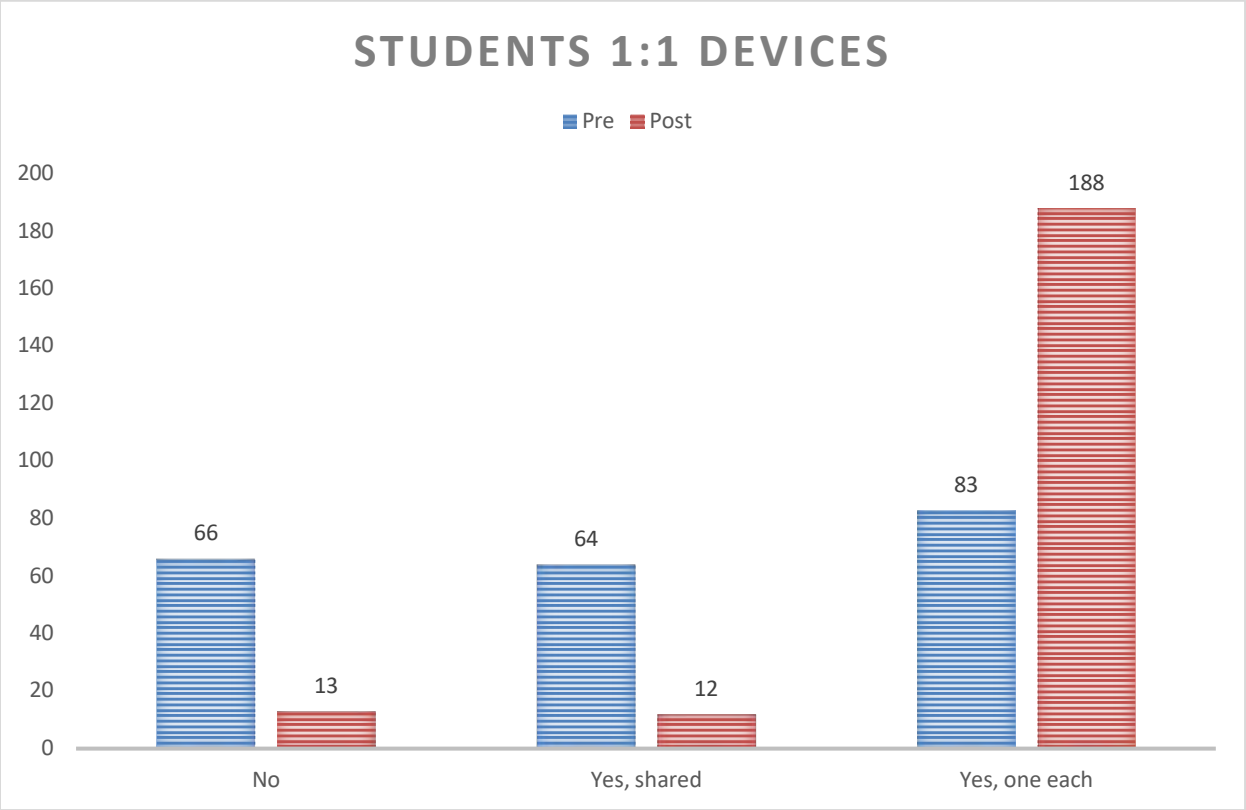
Addressing the third research question, the first theme that emerged was that when each student has their own device, it is easier to incorporate more technology into lessons and to use it more frequently. Since the pandemic shutdown, the vast majority of students have access to their own device. In fact, just 6% of teachers out of the 213 who responded to that question said their students did not have one-to-one devices (Figure 3). As Case 47 wrote, regarding classroom technology, "I used it daily [pre-pandemic], but now the students are using it daily as well." Case 104 added, "I used to use technology as a supplemental source prior to COVID. Now, I sometimes use it as a primary source for instruction" (Case 104).

The majority of teachers in this study said they would use one-to-one devices daily now that they are available. It also helps that lessons are available online for the whole marking period and "in case any students are absent, they can retrieve the material from their devices and complete the required activities" (Case 29). With every student having their own device it makes it easier for teachers to incorporate more technology into their lessons: Lessons are now "more tech driven, knowing students have their own device" (Case 2), and "now that school is one-to-one it is much easier to do online activities" (Case 4). It also helps that "students are more familiar with using chrome books now so it is easier to get them on quickly. Since students do not have to share devices, you can target many of them at one time instead of just one-on-one" (Case 13). Many teachers voiced the same sentiment as Case 128, who said,

> I believe allowing a student to have their own device will prevent them from getting distracted by sharing, and will allow them to work at their own pace without having to worry about being too fast or slow for their partner.

Figure 3

Number of students with 1:1 devices pre- and post-Covid-19 shutdown.

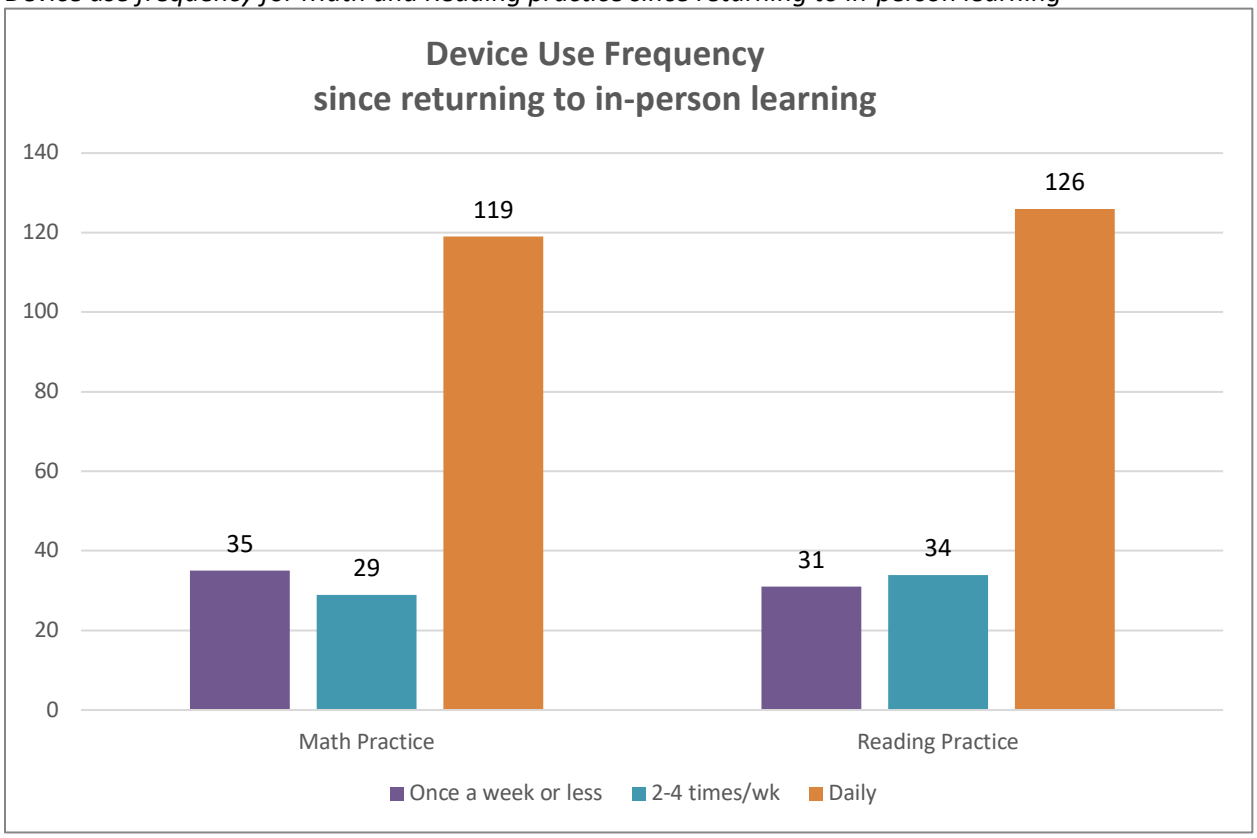


The second theme that emerged was that teachers are using one-to-one devices to individualize/differentiate lessons and to help catch up students on anything they may have missed. As Case 80 noted, now that students all have a device "I upload instructional support videos and resources to help them when they are behind or stuck. This helps me differentiate teaching and students are more independent learners." Case 165 commented that "it helps teachers collect data to help drive their small group instruction and interventions to close those learning gaps."

As each student now has a device, teachers have also been using them to help build up the skills that may not have been learned and/or practiced while students were learning remotely. "Students are in need of remediation of skills missed during the pandemic, therefore daily fact practice on the computer is an easy and fast way for daily practice" (Case 116). With the devices available, students do not have to wait for the teacher to help them, but can move ahead to the next lesson the teacher has prescribed: "Students can use tech for extra help using a variety of math/reading applications students can simply use by themselves" (Case 4). Case 27 noted that "mathematics is a subject that requires a great deal of practice and using online resources can be a great way to help bridge the gap." Responses to questions on frequency of device use showed that the vast majority of teachers have students use their devices for math and reading practice daily (Figure 4).

Figure 4

Device use frequency for Math and Reading practice since returning to in-person learning



In summary, it appears that teachers are leveraging their one-to-one device programs primarily for two purposes: first for differentiating instruction, particularly for struggling learners and second, for practicing basic and newly-learned skills. Teachers are incorporating more technology into their instruction now that students have a device each. Some are using their one-to-one devices to help engage the students and to allow them to explore new options. Others use them to have students work on basic skills that many students lack proficiency in, such as math and reading. There are many tools available to them now, that can allow students to work at their own level while they're developing these skills, and lessons can be differentiated for each student as they now each have a device.

Discussion

The 394 responses to the online survey regarding teachers' perceptions of the use of technology in the classroom at NJ Urban school district provided data on the ways teachers in the district use technology in their classrooms, their past and current experiences, and their opinions on the future use of one-to-one devices. The teachers' responses helped to enlarge the pool of information available on teachers' experiences during the shutdown of schools and how they coped with the sudden pivot to fully remote learning. Their comments and insights provided detailed information that both fit with, and expanded on, the results of prior research in a number of areas, including (1) the importance of professional development; (2) the sustaining effects of remote teaching and learning; and (3) one-to-one devices as a way to differentiate and better individualize teaching and learning.

Implications

Importance of Professional Development and Training

Professional development in technology has been cited as a necessity in the drive to get teachers to incorporate more technology in their classrooms (Hammond, 2017; Kopcha et al., 2020). Hover and Wise (2022) found that 79% of the teachers they surveyed would like professional development on how to integrate more technology into their classes. But simply offering professional development is not enough: it has to be relevant, to fit in with teachers' curriculum, and most importantly, teachers need to be given time to practice it before being mandated to use it in their lessons (Bauer, J., & Kenton, 2015; Cuban et al., 2001; Hammond, 2017; Superville, 2021).

As mentioned in the literature review, studies have found that a teacher needs 40 hours or more practice on a new application before feeling confident in using it (Hammond, 2017), but most professional development classes in NJ Urban are less than two hours long. This is an issue recorded in other research also (Ertmer & Ottenbreit-Leftwich, 2010; Hammond, 2017; Kopcha et al., 2020), and as such, it would seem that additional practice time provided to teachers would allow for a smoother rollout of new applications in the classroom. As the survey responses showed, many of the teachers said that having the extra time to practice using technology helped them gain confidence and feel more comfortable using it in the classroom since their return to in-person teaching. With the current shortage of teachers, it may not be possible to allow teachers extra time to practice their technology skills, but the recent suggestion by Winter et al. (2021) to provide teachers with buddies that they can work with to practice technology skills may be one method to try, as they can provide support and encouragement for each other both in and out of the classroom.

The teachers who responded to this survey bear out and support the earlier work of Bauer and Kenton (2005), Darling-Hammond (2017), and Cuban in various studies in the early 2000s. It is unfortunate that today's teachers still feel they do not get enough time to work on their skills. When given enough time, teachers are willing and able to learn new technologies and to incorporate them into their lessons. The NJ Urban district now has a number of different programs for class management, reading, writing, math, and science for teachers to choose from, but some teachers found it difficult to decide which ones to use, and so stuck to the ones they were most familiar with. Future professional development should try to expand teachers' repertoires by giving subject-specific sessions on the details of applications and then showing the teachers how to integrate them into their lessons, and how to move from one application to the next without disruption.

The NJ Urban district now uses Classlink which allows students to have one login for all applications, which eliminates the need to sign into individual applications. Therefore, it is easier for students to switch between applications without having to log out and then log in again. Some of the teachers do not yet know how to utilize this to their advantage in the classroom, so future professional development should be directed at getting the teachers familiar enough with switching between applications that they are encouraged to use more of them in their lessons. For example, the district now uses Nearpod, which has many pre-made lessons available on a variety of subjects. This application allows teachers to edit these existing lessons and it also allows for creation of new lessons from scratch, with links to videos, sound recordings, and gamified quizzes. However, many of the teachers do not yet know how to edit them, or to create their own lessons, so can only use the pre-existing ones, which may not suit their needs exactly. This application could be better utilized if teachers received professional development sessions that went into detail on all the options that are available, and then gave the teachers time to try them out and practice.

The data from this survey supported these previous studies, as many of the teachers said that although professional development was important in introducing them to new applications, having time

to practice those applications after professional development classes was what helped them become confident enough to include more technology in their instructional plans. Being able to select the topic themselves, instead of being told which application to learn, also helped teachers, by allowing them to choose the applications and topics that best fit with their instructional plans. A report by Bushweller (2022) on a recent survey by *Education Week* described how most teachers feel the professional development they receive is inadequate, and most importantly, that there is a lack of follow-up to see how teachers are doing. The majority of teachers in his study reported a "one and done" approach to professional development on technology, which is not very helpful to teachers as they try to integrate more technology into their lessons (Bushweller, 2022). This view is supported by the comments of teachers in this survey, that there needs to be better professional development, preferably with follow-up from a technology coach or leader within the school, to help teachers troubleshoot any problems they later encounter. In order to provide relevant professional development, it is important that school and district leaders not only emphasize its importance, but also talk to their teachers beforehand, to solicit their input on the type of professional development that would best benefit both them and their students (Cuban et al., 2001; Hammond, 2017; Superville, 2021).

A long-term goal in many school districts has been to procure one-to-one devices for all students. The COVID-19 pandemic accelerated that goal into a very compressed period, without time for sufficient professional development/training of teachers, with many being left to fend for themselves in regard to how the devices were going to be used to teach their students remotely (Machusky & Herbert-Berger, 2022). NJ Urban teachers have learned many lessons over the past 2 years-information which could be valuable to school administrators in planning future technology/application rollouts and/or professional development. Knowing how NJ Urban's teachers are using these devices in the classroom can help school administrators identify future professional development needs and may perhaps influence their decisions on whether or not to continue with a one-to-one device program.

Sustaining Effects of Remote Teaching and Learning

The responses to this survey also provide support for the sustaining effect of the intense period of technology use during the shutdown. The vast majority of teachers indicated that they now use more technology more often than they did prior to the shutdown. From the teachers' responses, it is clear the vast majority of them have gained new technology skills. It is important that teachers be encouraged to continue to develop their skills and to use them to help their students regain some of the lost learning they suffered due to the COVID-19 pandemic shutdown of schools. Ertmer et al. (2001), spoke of the extrinsic and intrinsic factors that dissuade teachers from using technology. They noted extrinsic factors were a lack of access to hardware/software, lack of time to plan instruction using technology, and lack of support from technicians and administration. Intrinsic factors were teachers' beliefs about teaching and technology, and their reluctance to change established classroom practices. According to Taimur et al (2021), the pandemic shutdown of schools essentially removed these barriers, as teachers had no choice but to use technology, and students had no choice but to learn on technology. This time focused solely on technology has resulted in an increase in skills and confidence for all parties concerned, and the question that now arises is: how do we sustain these changes and continue to incorporate technology into the majority of lessons?

Newmann (2021) suggests some practical ways to sustain these gains: we should celebrate the gains made by teachers, who have learned how to successfully incorporate more technology into their lessons, and who are mining its ability to differentiate learning and reach students at every level. These gains need to be built on, by providing teachers with appropriate professional development and time to practice integrating new applications into their lesson plans. Finally, teachers need to be asked for their input, to see exactly what their needs are, and to give them choices to select what type of programs would

best fit into their teaching repertoires.

This study took place at the end of the 2021-22 school year, when teachers had been back in the classroom for a full year after the COVID-19 pandemic shutdown, and the vast majority of teachers reported that they continued to use technology in more of their lessons than they had prior to the shutdown. This gives support to the findings of Darling-Hammond (2017), Taimur (2021), and Vu et al (2019) that appropriate professional development and time to practice are determining factors that increase the probability of teachers using classroom technology. It also provides hope that there may be a sustaining positive effect of the otherwise unfortunate time of remote teaching, if teachers continue to include more technology in their instructional lessons. The challenge now is to ensure that teachers feel supported in their technological development and that they are encouraged to retain and build on the gains they have made since March of 2020.

As mentioned earlier, according to a recent study of teachers in Ireland, one way to do this is to create a buddy system for teachers, where they are teamed up with another teacher, and work together to support and encourage each other in their efforts to integrate more technology into their classrooms (Winter et al., 2021). They also suggest that school district technology experts should provide support to each school as they work towards their technology goals. With continued support and encouragement from school leadership, the ideal prospect of sustaining the growth in technology knowledge and use by teachers in NJ Urban may become a reality.

The Potential Benefits of One-to-One Devices

Vu et al (2019), in their study on the implementation of a one-to-one program in a mid-western school district found that, with the addition of one-to-one devices, teachers discovered how useful one-to-one devices could be in helping struggling students become more engaged in their learning. As we try to help students increase their learning and catch up on any lost learning due to the period of remote schooling, one-to-one devices can be a useful tool. Teachers' responses to this study's survey indicated that they were now more familiar with how to use one-to-one devices to differentiate their lessons according to students' needs and abilities. With each child now having a device, it is easier for teachers to assign them work on their personal level and in areas where they need the most help. One-to-one devices can also help to keep those students who find working with pencil and paper difficult focus better on their learning and be more attentive to their lessons (Hover & Wise, 2022).

Conclusions

The biggest, and simplest takeaway from this study is that NJ Urban teachers need more time: time to learn, time to practice, and time to give and receive help on their journey towards technological fluency. This study has shown that teachers are quite capable of including more technology in their instructional lessons, and in fact, the vast majority of the respondents continue to include more technology in their lessons than they did prior to the period of remote teaching and learning in 2020-21. Teachers today have huge demands on their time, from students, from principals, from administration, from parents. The biggest service we can do for our teachers is to give them more time, to work on what they know and need to give our students the best education they can. It is time to appreciate all that our teachers do, and it is time to stop piling on extra tasks and paperwork that really do not help our students, but are put in place to help our administrators. Teachers are overwhelmed with paperwork, and much of it is unnecessary or "busy work" and of no direct benefit to students. With the current shortage of teachers and the increase in teachers quitting the profession, it may be time to hire more aides and/or clerical staff who can take on those time-consuming tasks that take teachers away from teaching. Reducing the amount of paperwork teachers are responsible for would give them more time to focus on what is really important

– their students' learning. It may also improve job satisfaction, and reduce the number of teachers wanting to leave the profession.

Apart from the fact that all teaching was done using technology during the pandemic shutdown, another huge factor was that teachers were given back the time that they would normally spend creating progress charts, graphs, and reports for display in the classroom or hallway, or to send to the principal or administrators at their schools; they no longer had to sit through department or school-wide meetings. With this extra time, teachers had the opportunity to explore and learn about technology in a way which was impossible before, and our teachers are better for it. They now have more tools in their pockets to help them reach every child, to help bring up to standard those students who struggle, and to stimulate those students who are ready to forge ahead with something new. It is very important for us to give teachers time to learn, as well as time to teach, because every time a teacher learns a new skill, they pass it on to their students, and we all win when that happens.

In terms of future research, surveying teachers in different types of districts would be interesting to see if their perceptions of classroom technology are consistent with those in NJ Urban. It may also be of benefit to survey students, to explore their perceptions of one-to-one devices and classroom technology, to see how they feel they can best benefit from them.

In conclusion, the results of this study show that one-to-one devices are now an integral part of many NJ Urban teachers' instructional strategies. They are being used not only to help catch students up on what they missed during the period of remote learning, but also to differentiate lessons according to students' interests and abilities. There are many applications that can allow students to explore places and things that they are not familiar with, and applications like virtual reality tours can help expand students' understanding of other countries and cultures.

While one-to-one devices may help expand students' horizons, they are no substitute for good pedagogy. Following the shutdown of schools for so long, there is now a greater need than ever for good teachers, and a need for an increased emphasis on basic skills, such as reading, handwriting, and math, to enable students to reach their full potential. Teachers have worked hard to improve their technological skills and are now using them in the classroom more frequently to benefit students. In order to sustain this increased use, their efforts should be recognized and rewarded, and teachers need to be supported as they work to expand their technological repertoire.

The implications for administration are that NJ Urban teachers should be consulted and included in discussions on district policy regarding purchase of new applications, to make sure they actually fit with the curriculum, and with the teachers' instructional methods, and to avoid spending money on applications that teachers will not use. When planning for professional development programs, it would behoove NJ Urban administrators to budget more time for teachers to learn and practice their new technology skills, in order to grow and sustain the gains they have made over the past two years.

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Appendix A
Sample of Survey Questions on Classroom Use of Technology

This survey is to explore how your instructional practices regarding technology may have changed after a year of remote learning. As such, the first set of questions should be answered from the perspective of your pre-pandemic practices (prior to March, 2020), as best as you can recall. The second set of questions should be answered from your current perspective, since you returned to in-person teaching for the 2021-22 school year.

Q5 Prior to the Covid-19 Pandemic shutdown (March 2020), did you have a Smartboard/Promethean board in your classroom? No/Yes/Do not recall
Q6 How often did you use your Smartboard/Promethean Board with your students?
Once a week or less /2-4 times per week /Daily /Do not recall
Q7 Did your students have a school-issued device to use prior to the Covid-19 Pandemic shutdown?
No /Yes, one shared with other students /Yes, one per student /
Q8 Did you have a school-issued laptop/PC for your use?
No /Yes /Yes, but I preferred to use my personal laptop /Do not recall
Q9 How often did you use your laptop/PC for the following tasks?
Daily /2-4 times per week /Once per week or less
Email /Grading /Lesson planning /Online meetings: Zoom/Google Meet, etc. /Professional development /Research for future lessons

Please answer the remaining questions from your current perspective, having returned to in-person teaching (2021-2022 school year).

Q10 Do your students currently have a school-issued device they can use?
No /Yes, one shared with other students /Yes, one per student
Q11 How often do your students use their 1:1 devices for the following tasks?
Once a week or less (1) 2-4 times per week (2) Daily (3)
Communicating with you/other teachers /Cooperative or group projects /Creating presentations /Practicing math online /Practicing reading online /Researching a topic for class /Responding to an activity on Smart or Promethean Board (e.g. Kahoot, Quizizz, etc. /Writing assignments
Q12 Are there other activities for which students use their 1:1 devices?_____
Q13 Since you returned to in-person teaching (2021-22), how often do you use 1:1 devices with your students? Once a week or less /2-4 times per week /Daily (3)
Q14 Has the number of times you use 1:1 devices changed from what it was prior to the Covid-19 Pandemic shutdown?
Yes, I use them less now /I use them the same amount as before /Yes, I use them more now
Q15 Why has your use of 1:1 devices changed?_____
Q16 If you had the choice, how often would you choose to use 1:1 devices with your students?
Once per week or less /2-4 times per week /Daily /
Q17 Are your students typically allowed to bring their 1:1 device home?
No /Only when going to remote learning /Yes
Q18 Do you now have a school-issued laptop/PC for your use?
No /Yes /Yes, but I prefer to use my personal laptop
Q19 How often do you now use your laptop/PC for the following tasks?
Once a week or less /2-4 times per week /Daily
Email /Grading /Lesson planning /Online meetings: Zoom/Google Meet, etc./Professional

development /Research for future lessons

Q20 Compared to before the Covid-19 Pandemic shutdown, how comfortable are you now with using technology in your lessons?

Less comfortable /About the same as before /More comfortable

Q21 What has changed about the way you use technology in your lessons, since you returned to school in September 2021?

Q22 Why have you made these changes in the way you use technology to teach?

Q23 Which of the following would encourage you to increase the use of technology in your instructional lessons? Select all that apply.

having a technology coach in my school /more professional development /support from administration /support from other teachers /time to practice new applications /Other

Q24 How much learning loss do you think your students have after being remote during the Covid-19 Pandemic shutdown? None /A little /A great deal

Q25 What do you think is the most important thing teachers need to focus on right now?

Improving math /Improving reading /Improving writing /Social emotional learning /Other/All the above

Q27 What are your perceptions on using 1:1 devices to help reduce learning loss?