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Digital divide and teaching modality: It's role in technology and instructional strategies

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Abstract

This quantitative study aimed to better understand how teachers implement technology in a variety of teaching modalities to enhance content delivery and student engagement. More specifically, it aimed to investigate the digital divide of technology usage based upon school setting and usage frequency. Responses were collected using a random sampling method of full-time K-12 public school teachers in a Mid-Atlantic state. The instrument was developed from prior research and examined educator usage frequency of instructional technology in urban, rural, and suburban schools dependent upon teaching modality. A total of 423 participants responded to the researcher-created questionnaire and yielded practical implementations for further study. The findings uncovered significant differences in usage frequency of rural, urban, and suburban teachers utilizing technology dependent upon modality (ex. cooperative learning, small group instruction, student-led research, problem-solving). Results of this investigation contribute to the field through an attempt to foster a discussion of disparities between the integration of technology and school setting. The purpose of this discussion is to identify gaps in the digital divide, apply frameworks geared toward equity, and create professional development opportunities for all educators to differentiate technology usage across multiple teaching modalities.

Keywords Urban schools · Rural schools · Digital divide · Educational technology · Teaching modality

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1 Introduction

It is not easy to overstate the prevalence of technology in 21st century culture, as it has transformed the social, political, and economic environment in which students and teachers teach and learn. The United Nations declared access to the internet a fundamental right (Reglitz, 2020) because it "enables…a range of…human rights" (p. 314), such as "economic, social and cultural rights. Additionally, according to the UN (Reglitz, 2020) internet access is an integral part of securing basic human rights, including "the right to education and the right to take part in cultural life to enjoy the benefits of scientific progress and its applications, as well as civil and political rights, such as the rights to freedom of association and assembly" (p. 317). The UN argues internet access "should be a priority for all States" (p. 319) to level the playing field of social and economic inclusion and mitigate negative effects of socioeconomic barriers.

Although computer and internet access appears to be widely available in schools across the United States, some school buildings may have too many computers while others have few or none. In many cities and school districts, the level of disparity between access to technology and adequate knowledge on utilizing technology is very high (Lynch, 2017). Rather than pertaining to only the relationships between technology's role in education in developed or developing countries or urban or rural communities, the digital divide exists between schools in the same district that are a few miles away or the next neighborhood over (Huffman, 2018). In large part, because of the economic and human resources some schools have and other schools are lacking, more than ever before, a student's childhood street address can have a substantial impact on educational and professional achievement later in life (Madathil, 2019). Schools with adequate facilities, including computer labs, laptops, and padlets, can help to reduce the digital divide as many students can utilize technology and the internet only at school.

At home, elementary learners frequently lack an electronic device or internet connection compared to older students. As prior research found, academic achievement is correlated with access to computers at school and home, demonstrating this inconsistency in success is a cause for concern (Judge et al., 2006). For internet-dependent assignments which require work outside of the classroom, a number of students lack the tools necessary to perform and complete their tasks. This disparity leads to a number of inequities between learners (McLaughlin, 2016). In these inequitable circumstances, rather than enhance education, technology can actually hinder effective education for disadvantaged populations of students (MIT News, 2019). This recognition of a digital divide should demonstrate the importance of modifying expected learning or teaching modes based upon technology, and having equitable access to information and communication technology for learning.

This quantitative study aimed to better understand the digital divide in K-12 schools related to technology usage based upon expected student learning mode in American public schools. This manuscript seeks—from the perspective of teaching and learning—to describe and discuss specific teaching strategies in which teachers employ technology. Specifically, the investigation sought to better understand teacher usage frequencies of technology dependent upon teaching modality and rural, urban, and suburban schools. Participants identified how often they incorporated technology dependent upon teaching modalities (cooperative learning, individual instruction, small group instruction,) and interaction with learners (student research tool, problem-solving tool, communication tool),

This manuscript hopes to further the literature around the digital divide and teacher technology use and training by providing the reader insight about these topics in an attempt to close the pervasive gap. While previous studies analyzed the digital divide based on teacher perceptions and usage frequencies, little can be found in the literature focused on teaching modality. In a 2020 study of 268 teachers, significant differences were found between urban, rural, and suburban K-12 educators related to perceptions of technology effectiveness, with both urban and rural respondents significantly lower than their suburban peers (Murphy, 2020). Further, educators in rural and urban communities utilized technology less frequently and faced larger barriers to implementation than suburban teachers (Kormos, 2021; Kormos & Wisdom, 2021).

2 Literature review

2.1 K-12 students as digital natives

Technology is now commonplace to fill a variety of communication and educational purposes to the point where they see devices as an integral element of daily life (Bennett, 2012). As an example, Pew Research Center (2019a, b) found 81% of Americans stated they would be disoriented if their smartphone had been misplaced. This is especially true for urban learners where students are most likely to be smartphone-dependent and not have a wide range of technology available at home. Smartphones feature internet browsing, voice typing, video recording, and keyboards, and other capabilities found on computers. This statistic illustrates the necessity for fair and equitable access to technology. Furthermore, Cram et al. (2011) believed technology integration encompasses the capacity to serve as a *disruptive innovation*:

> “These combinations of innovations and technologies enable alternative ways of learning about the world that no longer require the industrial organization of the classroom wherein learning and teaching activities and processes are achieved through the teacher-centric control of pedagogy, knowledge and technologies.” (Cram et al., 2011, p.2)

The evolving digital nature of society has led to a new model of students. In conversations related to educational innovation, especially related to the usage of instructional technologies or the need for more effective pedagogies, the term *digital native* (Prensky, 2006) can be found. Surrounded by smartphones, computers, tablets, etc., today’s learners “think and process information fundamentally differently from their predecessor” and are “native speakers” of the digital language (Prensky, 2001, p. 14). According to Prensky, those born after 1984 comprise an ever-growing group of children, adolescents, and young adults who have been immersed in digital technologies their entire life. For those born before 1984, they are referred to as *digital immigrants*. As a result, he argues, this exposure to digital technologies has given these people specific and unique characteristics that make its population unlike previous generations. It is thought digital natives inherently possess advanced digital abilities and learning preferences not commonly employed in the traditional education system, which is viewed as unprepared and incapable.

Presky was not the only researcher who assumed children understood what they were doing with technology based upon observation of them using devices effectively and efficiently, which could lead to learning that allows them to take advantage of their inherent skills. Veen and Vrakking (2006) introduced the term *homo zappiëns* in reference to a generation of learners which has developed and refined—despite little guidance or instruction from others—metacognitive skills necessary for experiential or collaborative learning, along with self-organization, self-regulation, and explicit knowledge. Other labels include Net generation (Oblinger & Oblinger, 2005), iGeneration (Rosen, 2007), and Google generation (Rowlands et al., 2008). There may be validity to this labeling, as a large number of young adults, adolescents and children actively support adult technology usage (Correa, 2014).

Previous research found digital native students, all born after 1984, do not have a breadth of knowledge of technology, and what is known is generally contained to the capabilities and use of word processing or presentation software, email, text messaging, social media, and searching the world wide web. Margaryan et al. (2011) found that although digital native students do actively use digital technologies, those employed for learning and socialization are minimal. According to Bullen et al., 2008), these students lacked understanding of the enhanced functionality of their technologies and the capabilities of various applications. As a result, additional training in effective technology use for learning and problem-solving is required. When digital native students did use technology for learning, it was largely composed of unengaged acquisition of information or viewing an instructor-recorded presentation. To effectively engage students, today's educators need to be prepared to adopt a diverse set of educational strategies.

2.2 Teachers as digital immigrants

Many teachers and administrators today are *digital immigrants* who were born before 1984 but have adapted and implemented many aspects of technology. However, teachers that are digital immigrants often retain a large percentage of their pre-digital mindset. As a result, traditional preservice educator training needs to be adapted to incorporate innovative technologies in the learning process (Kirschner & Bruyckere, 2017). The diversity of technology skills within digital native and digital immigrant generations highlight the need for implementation to maximize educational outcomes. Doll et al. (2021) questioned the value of the steady effort to categorize users in sweeping terms and prioritize the benefit in examining variables besides age that can shape technology usage. Other variables such as access issues, gender, socioeconomic status, cultural background, home stability, and student interest or teacher interest are correlated with technology use (Camera, 2020).

Like many relationships between teachers and students, it features a co-created learning community where technology is effectively integrated. It is important educators also realize that some learners born in 1985 or later may need time to develop the necessary technological skills for a 21st-century classroom. Specifically, educators need to structure the learning process to build skills and allow for hands-on application (Creighton, 2018). With the ubiquitous presence of technology via multiple hardwares such as computers, tablets, and smartphones, educators can integrate technologies they and their students utilize outside of the classroom. Prior research found learners do not expect the implementation of technologies that educators and schools cannot employ effectively (Angeli et al., 2017). Further, students and faculty can perceive technologies from the perspective of learners or educators, instead of simply age-related differences (Doll et al., 2021). This is not necessarily true, especially considering the growing numbers of educators born and educated after 1984 who are now veteran educators (Valtonen et al., 2011).

Outside the classification of digital native and immigrant, White and Le Cornu (2011) pointed to a continuum ranging from visitor to resident. Visitor/resident does not infer a negative connotation related to greater technical skills of either population. Rather, the continuum is not concrete and fluctuates depending upon personal needs and objectives. Users of technology take upon different rules based on need, knowledge, and familiarity. A resident can become a visitor, while a visitor can become a resident. A move away from the digital native/immigrants binary encourages teachers and students to reflect upon their movement within the continuum, interacting and helping one another without preconceived notions. Since today's students are digital natives, they likely utilize at least one technology hardware for personal or educational use on a consistent basis (Diemer et al., 2012). This hyperconnectedness of students of all ages is a paradigm shift from prior generations and requires innovative pedagogy and strategies in the classroom.

2.3 Digital divide in schools

A 1996 the U.S. Department of Commerce report first coined the term digital divide first appeared in and was centered on the disparity between the "haves" and the "have nots", those who did or did not own a computer (Dolan, 2017). When initially mentioned, the term applied technology access. However, this definition has evolved to include multiple characteristics of computer access, specifically inequality in software, hardware, internet connection, demographics, and gender. Instead of reducing the digital divide for K-12 learners, prior research indicated it continues to be complicated and growing (Dolan, 2016). While the previous two decades featured advances in overall access to the internet and technology, it remains students from low socio-economic backgrounds who would benefit from it most, although they are least likely to have access. Even when the internet and technology are accessible, users do not always have the pertinent knowledge to use them appropriately and effectively (Huffman, 2018).

Creighton (2018) mentioned it will be a challenge for educators to reduce gaps in digital equity until all learners are provided either a stable internet connection with a local provider or hotspot to logon outside of the classroom. Despite measures and policies to close the digital divide, deficiencies continue to exist related to learners and their at-home internet access. A NCES (2018) study revealed learners with an internet connection at home averaged higher performance levels than those lacking reliable access. The study also found learner demographics were a predictor of home internet access. Results from the NCES study (2018a) indicated elevated household parental education and income level increased the likelihood of access. In 2017, nearly 90% of homes in the U.S. had access to a computer at home, while 77% of respondents stated they had stable internet connection. Nearly 80% of respondent households had high-speed internet service and 68% of children accessed the internet outside of the school day via a mobile internet service or data plan (NCES, 2018b).

Increased technology usage in the teaching and learning process produces learners with the abilities to increase confidence related to 21st century skills (Rowsell et al., 2017). However, if student usage inside and outside of the school building are correlated to academic achievement, any disparities should raise red flags (Bach et al., 2018). Relationships between socioeconomic status, access to digital learning resources, and student achievement also persist. In 2017, the National Assessment of Educational Progress (NAEP) found lower mean reading scores for eighth graders who did not use a computer at home compared to their peers who reported consistent usage. Furthermore, eighth graders with home internet access received higher scores than those who did not (NCES, 2018b). For students who find success at school, their technology capabilities can be well developed and creative. However, for those who struggle, a scarcity of opportunities to employ technology worsens educational outcomes (Dolan, 2017).

Learners from low socioeconomic households are less likely to own hardwares essential to academic achievement and provide families a communication medium (McLaughlin, 2016). Insufficient or nonexistent home internet access can negatively impact learners. Without it, students are unable to connect with teachers and classmates, conduct research, or access learning management systems for materials and work. A lack of home internet service does not only impact students. For parents, families, and caregivers, a lack of internet access removes a line of communication with the district as a whole, individual school buildings, administrators, and teachers that can result in unawareness of important information such as a school closing or student work in a particular classroom (Lynch, 2017).

While some may think in a world with constant access to technology and the internet, this is not true for many, specifically young learners, adolescents, and young adults (Roswell et al., 2017). The NCES (2018b) found learners 5 to 17 years of age and living below the federal poverty line were significantly less likely to have home internet access than learners in a household between 180 and 185% of as well as from 185% or higher from the poverty line (2018b). A 2015 Pew Research study revealed low-income homes are most susceptible. According to the study, 31% of households with yearly income under $50,000 lack internet access at home. In contrast, only 8% of learners from households with an annual income of over $50,000 did not (Lynch, 2017). The physical location in which a learner resides may hinder home internet access. Those in remote rural communities were less likely to have adequate infrastructure for internet providers than their peers who lived in suburban urban environments (NCES, 2018b).

The NCES study also revealed gaps in access dependent upon the ethnicity of learners. Specifically, American Indian/Alaska native, Black, and Hispanic learners were less likely to have internet access at home compared to learners who identified as White, Asian, or two or more races (NCES, 2018b). Ninety-two percent of Asian and 88 percent of White households with students in grades K-12 contained high-speed internet access. Meanwhile, for Black and Hispanic households, only 72% of households were connected (Lynch, 2017). This group also includes students who may lack access at home to essential technology resources. The United States Department of Education found approximately 9.4 million learners, or 14% of children ages 3–18, lack home internet access. Some internet advocacy groups advocate the population of learners without internet access may actually be 12 million (Camera, 2020).

Even if students have access to the internet, they may not have the ability to utilize essential technologies. According to a 2019 Pew Research poll, 89% of grades 9–12 learners and 73% of middle learners use smartphones. For all respondents, only 66% reported they had access to laptops. For learners in grade 3–5, a slight majority of students owned smartphones, 62% utilized laptops, and 58% worked on tablets. Furthermore, 21% of K-2 learners used smartphones and nearly half utilized laptops and/or tablets. The effects caused by lack of access at home particularly affect students of color leading them to be at a disadvantage and susceptible to potential struggle or barriers to their education. Despite the usage of technology by young learners, they are less likely to have their own device with internet capability compared to those in the middle grades or high school. Even when this learner population does live in a household with an internet connection, the needs of an older brother or sister, as well as a parent or guardian, may take precedence. In this case, young learners would need to wait to use a specific device.

2.4 Theoretical framework

Media Dependency Theory is seen as relevant to serve as a guidance related to usage of educational technology by teachers dependent upon teaching modality. More specifically, it helps researchers organize and understand how educators utilize technology in the communication process, including dissemination of content and collaboration. First presented by Ball-Rokeach and DeFleur (1976), the framework suggested the principle of media dependency and reflection on the interactions between the elements of multiple networks. Further, the theory also examines how various social structures (economic, geographical, and educational) and the societal context contribute to a school's knowledge system (Carillo et al., 2017).

The theory can serve as a guidance in an educational technology study because it suggests people become more dependent on media, which will influence user perceptions and impact behaviors. MDT utilizes an interactive relationship of three variables based on a reciprocal relationship dependent upon each other (Ball-Rokeach & De Fluer, 1976). First, a social system which is dependent on the stability of the social structure. The second component is technology usage that serves as the main source of information and interaction. Lastly, the audience is dependent upon educational technology as the primary source of information. When done correctly, interaction between each of the variables fosters effective communication, including cognitive, affective and behavioral domains (Madianou & Miller, 2013).

Emerging developments in educational technology allow for a more diverse student- content relationship. Typically, digital platforms rely upon an established school structure supported by existing social and economic systems (Ball-Rokeach, 1998). MSD, which has expanded its conception of a media system to meet the changing landscape in today's digital era of education and remains useful and highlighting the intertwined relationship between teaching, learning, and technology. MSD's sensitivity to interactions between technology end learners is directly impacted by an individual learner's cognitive, behavioral, and effective needs to best deliver content and promote interaction between students, teachers, and other stakeholders such as parents and administrators (Zhang & Zhong, 2020).

3 Methodology

3.1 Participants (Table 1)

Table 1 Participant characteristics

Variables	Total ($N=423$)
Age in years	
Mean ± SD	43.26 ± 7.5
Min–Max	23–71
Years as a Full-Time Educator	
Mean ± SD	12.09
Min–Max	1–49
Gender	
Female	276
Male	87
No Reply	2
Grade(s) Taught	
Grades K-4	170
Grades 5–8	190
Grades 9–12	146
Content Areas	
English/Language Arts	112
Math	180
Social Studies	89
Science	86
Special Education	71
School Setting	
Rural	110
Suburban	199
Urban	104

3.2 Survey instrument

This quantitative study utilized survey research methodology to explore public school teaching modalities intended by the use of integrated technology. A survey was employed due to the ability to collect and interpret cultural, psychological, economic, social, technical and other categories of data (Fowler, 2013). The survey included statements from prior studies and survey instruments (Bach et al., 2018; Ritzhaupt et al., 2012), specifically items related to modality and teacher perceptions. The initial part of the survey included 11 intended purposes of learning through the use of technology. The final portion contained demographic questions such as age, gender, years of full-time teaching experience, grade level(s), subjects taught for middle grades and high school teachers, geographic setting, class size, and school building socioeconomic status. The survey consisted of multiple question types related to teaching modality with technology. Respondents rated their agreement to specific questions related to the study with items on a five-point ordinal category scale (1 = 'Not at all' and 5 = everyday).

For the purpose of this study, respondents self-identified the location of their school building. The National Center for Education Statistics (2014) provided operational definitions for the urban, rural, and suburban school response options. The NCES defined *urban schools* as situated inside a city, containing at least a 20% concentration of minority students, and at least one in five students receiving free or reduced lunch. *Suburban schools* were described as those in an urban locality surrounding a city, but not in a rural zone. These schools featured a student population with under 20% diversity related to socioeconomic status and ethnic background. The NCES characterized *rural schools* as found in a municipality or agricultural zone containing a population of under 25,000 people.

3.3 Data gathering

A publicly available State Department of Education email list provided contact information for each public school principal. Participants were selected via simple random sampling of K-12 public school teachers.The researcher utilized Survey Monkey as the survey platform. Principals were contacted via an email from the researcher's work email address and requested to forward the hyperlinked survey to their faculty. The informed consent, description of purpose, and a hyperlink to the survey were included in the email. Two weeks after the initial email, a follow up was sent to each provided email with a message to please forward the survey as a reminder to participate. The survey remained open for a total of four weeks.

Quantitative data was collected to answer the following research questions:

RQ1: Is there a significant difference between urban, rural and suburban teacher usage of technology based on teaching modality?
RQ2: Is there a significant difference between urban, rural and suburban teacher usage of technology based on teaching modality and interaction with learners?

4 Statistical analysis

Data were formatted and analyzed using the Statistical Package for Social Sciences 26.0. After descriptive statistics and frequency tables were generated for demographic variables, Cronbach's alpha was calculated for each subscale to determine the internal consistency of items and gauge their reliability. The results show the instrument reaches an acceptable level of reliability for both elements including the teaching modality ($\alpha = 0.77$) and interaction with learners ($\alpha = 0.89$).

Objective one investigated technology implementation during small group instruction based upon school setting. A one-way ANOVA yielded a significant relationship between groups [F, (2, 358) = 5.650, p = 0.004). A Tukey HSD test found significantly lower mean scores for urban teachers (M = 263; SD = 1.47) than suburban teachers (M = 3.15; SD = 1.38) with a difference of -0.521 and a p value of 0.013, and rural teachers (M = 3.28; SD = 1.42) with a difference of -0.648 and p value of 0.006. Overall, teachers indicated satisfaction with technology access in their school building (M = 3.80; SD = 1.05). Taken together, responses suggest educators in urban schools were significantly less likely to employ technology within small groups than their peers (Table 2).

Objective two investigated teacher usage of technology for individual instruction (Table 3). A one-way ANOVA found no significant effect between the variables [F, (2, 358) = 2.903, p = 0.056.

The third objective explored the use of technology as a cooperative learning tool. A one-way analysis of variance found a significant relationship between variables (F (2, 358) = 4.028, p < 0.019). Post-hoc comparisons using the Tukey HSD test suggested the mean score differences of urban teachers (M = 2.75; SD = 1.24) were significantly lower than educators in a suburban school (M = 3.38; SD = 1.20) with a difference of -0.477 and a p value of 0.017. Rural teachers did not significantly differ from either group (Table 4).

Objective four examined differences in school setting and the use of technology as a reward (Table 5). A one-way ANOVA uncovered no significant relationship between school settings [F, (2, 354) = 1.291, p = 0.276.

The fifth objective measured differences in the use of technology during independent learning. A one-way ANOVA suggested no significant effect brought upon by school setting at the p < 0.05 level [F, (2, 355) = 1.482, p = 0.484 (Table 6).

Objective six investigated technology integration as a classroom presentation tool. Data analysis revealed no significant relationship (Table 7).

Table 2 Small group instruction

	N	*M*	*SD*
Overall group	361	3.06	1.43
Rural	96	3.28	1.42
Suburban	175	3.15	1.38
Urban	90	2.63	1.47

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 3 Individual instruction

	N	*M*	*SD*
Overall group	359	3.27	1.44
Rural	95	3.47	1.46
Suburban	175	3.31	1.42
Urban	89	2.98	1.43

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 4 Cooperative learning

	N	*M*	*SD*
Overall group	361	2.74	1.36
Rural	96	2.82	1.33
Suburban	174	2.87	1.33
Urban	91	2.40	1.38

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 5 As a reward

	N	*M*	*SD*
Overall group	357	2.36	1.42
Rural	95	2.40	1.44
Suburban	171	2.24	1.39
Urban	200	2.75	1.24

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 6 Independent learning

	N	*M*	*SD*
Overall group	358	3.30	1.43
Rural	95	3.26	1.45
Suburban	173	3.39	1.41
Urban	90	3.18	1.43

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

The seventh objective explored how frequently teachers employed technology to promote student-centered learning. A one-way ANOVA was conducted and found no statistically significant relationship between school setting [F, (2, 354) = 0.233, p = 0.885 (Table 8).

For objective eight, an analysis of variance showed no effect of school setting on teacher usage of technology as a student research tool [F, (2, 356) = 2.274, p = 0.290 (Table 9).

The ninth objective measured technology and problem-solving. A one-way ANOVA revealed significant disparities [F(2, 356) = 5.306, p = 0.042)] associated with school setting. Post-hoc comparisons using Tukey's HSD revealed the difference of means for urban teachers (M = 2.61; SD = 1.42) was significantly lower than suburban teachers (M = 2.98; SD = 1.37) with a difference of -0.236 and a *p* value of 0.048. However, usage did not differ significantly between rural teachers and their peers (Table 10).

Objective ten investigated technology as a way to improve student productivity. Data analysis revealed no significant relationship between school settings (Table 11).

In the final objective, a Levene's test revealed an inequality of variances ($F = 5.145$, p = 0.006). To further investigate, a *Welch's F* test [$F(2, 191.78) = 4.791$, p = 009)], found school setting was statistically significant. For post hoc comparisons, the Games-Howell procedure indicated the mean responses for urban teachers (M = 3.18; SD = 1.69) was significantly different from suburban educators (M = 3.78; SD = 1.50) with a difference of -0.604 and a *p* value of 0.013. A significant effect between urban and rural teachers (M = 3.28; SD = 1.42) was also found, with a difference of -0.641 and *p* value of 0.018. No Post hoc comparisons revealed a significant effect between rural and suburban teachers (Table 12).

Table 7 As a classroom presentation tool

	N	*M*	*SD*
Overall group	357	3.45	1.45
Rural	94	3.39	1.45
Suburban	174	3.60	1.41
Urban	88	3.22	1.52

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 8 To promote student-centered learning

	N	*M*	*SD*
Overall group	357	3.33	1.38
Rural	94	3.28	1.45
Suburban	174	3.36	1.35
Urban	89	3.31	1.37

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 9 As a student research tool

	N	*M*	*SD*
Overall group	359	2.95	1.35
Rural	94	3.04	1.31
Suburban	175	2.99	1.35
Urban	90	2.76	1.40

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 10 As a problem-solving tool

	N	M	SD
Overall group	359	2.91	1.37
Rural	94	3.04	1.31
Suburban	175	2.98	1.37
Urban	90	2.61	1.42

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 11 As a productivity tool

	N	M	SD
Overall group	357	2.57	1.43
Rural	94	2.63	1.35
Suburban	174	2.62	1.45
Urban	89	2.40	1.47

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

Table 12 As a classroom communication tool

	N	M	SD
Overall group	358	3.64	1.58
Rural	94	3.82	1.45
Suburban	174	3.78	1.50
Urban	90	3.18	1.69

1 = not at all, 2 = once a month or less, 3 = once a week, 4 = several times a week, 5 = everyday

5 Conclusion, discussion and implication

This study sought to investigate the relationship between school settings (urban, suburban, and rural) and the use of technology in K-12 education and how both components contributed to and displayed the digital divide in classrooms across the United States. This study surveyed teachers in urban, suburban, and rural school districts on the technology in their teaching and learning practices in the following outcomes: enhancing small group instruction; strengthening individual instruction; increasing cooperative learning; promoting compliance through inclusion in a reward structure; supporting independent learning; augmenting classroom presentation; promoting student-centered learning; supplementing student research; aiding problem-solving; improving student productivity; and boosting classroom communication. Teachers were asked to report on the level of technology use as it applied to each type of learning outcome; answers ranged from zero usage to using technology every day. The type of school setting was not found to matter to any significant degree in seven out of the 11 educational technology outcomes surveyed. Careful analysis of teacher responses showed that there were not any statistically significant differences between urban, rural and suburban teaching using technology as part of a reward system, as a classroom presentation tool, as a student research tool, to improve student productivity, to promote student-centered learning, to cultivate independent learning, and augment individual instruction.

The study did find that school settings did make a statistically significant difference in how technology was used in K-12 classrooms as a communication tool, as an aid in problem-solving exercises, as a cooperative learning tool and within small-group instruction. The results showed urban teachers were likely to use technology as a classroom communication tool as compared to those in a suburban or rural school building. No statistically significant difference was found between how suburban and rural teachers used technology to enhance classroom communication. Results also showed that urban teachers used technology as a problem-solving aid far less than suburban teachers did; additionally, urban teacher technology usage frequency during cooperative learning was significantly less than suburban teachers, although the rate of usage by rural teachers was not significantly different for either group. Finally, the results indicated that urban teachers were much less likely to use technology within small groups than teachers in rural and suburban districts.

Although significant differences between technology use and school settings were only found in 4 out of 11 of the objectives surveyed, it is worth noting that in all 4 cases with statistically significant differences, urban teachers reported using technology less frequently than suburban and rural teachers. There may be several different factors that contribute to this phenomenon, including lack of training for teachers on how to effectively and appropriately use technology in the classroom, and lack of student access at home and at school to technology and the internet.

Prior research has shown that providing teachers with more than just knowledge about basic internet usage (email, search engines, etc.) is arguably more important in urban school districts than in other types of communities because disadvantaged students need to be technologically proficient to succeed in an ever-increasingly technologically dependent work force (Mouza, 2011). Although teachers are required to engage in a certain number of professional development sessions per year (hours vary by state), many times the professional development sessions which focus on technology training do not go past basic information or delve into "knowledge integration or flexible application of technology" (Mouza, 2011, p. 1). In short, teachers often learn the logistics of technological systems but not how they could be innovative and employ those technologies in their teaching and learning practices to better serve their students.

Additionally, previous research has shown direct links between a student's access to the internet, and socioeconomic status to academic performance and, later in life, earning potential (Bach et al., 2018). Families in lower socioeconomic brackets are more likely to not provide computer and internet access. Prior research has shown that school-age children in urban areas were over 50% as likely to be living under the poverty line as suburban children, and 25% more likely to live in impoverished conditions than children in rural communities or places with a low population density (NCES, 1996). Without access to the internet at home, many students would be at an obvious disadvantage if earning high grades was predicated on using the internet to complete group work, day-to-day homework, or independent research projects. Urban teachers familiar with their student population may hesitate to use technology in their instruction because they are aware of the discrepancy between those who have access to technology and those who do not. By not incorporating technology into classroom instruction as often as their rural and suburban peers, they may be attempting to mitigate the negative effects of the digital divide and not make it harder on an already disadvantaged population to succeed in the K-12 school system.

5.1 Moving forward

Given the overwhelming role technology plays in the daily lives of most Americans in the 21st century, it is clear that students who are technologically proficient will have a better chance of succeeding in educational and professional settings. It is more important than ever to breach the digital divide between students who have access to technology and the internet, and those who do not have either any access, inconsistent access, or insufficient access. Since the outbreak of Covid-19, many schools across the world and in the United States have had to shift to a hybrid or completely online teaching and learning model. As such, the digital divide and its potentially disastrous effects were revealed to the general public and have generated greater interest in closing the gap between the 'haves' and the 'have-nots'. According to a 2018 from Common Sense Media and Boston Consulting Group study, 15 million American school-age children did not have access to the internet or a device with which to access it; 10 million lacked both the internet and a device. Additionally, 300,000 K-12 teachers in the United States did not have sufficiently stable high-speed internet access to teach school from their homes (Cookson & Edgerton, 2020). Additionally, the PEW Research Center (2020) reported that almost 60% of parents with K-12 age children in lower economic brackets feared their child might fall behind in their schoolwork because of the lack of high-speed internet and or a computer or tablet.

One recommendation for future research is to replicate this study to see how K-12 teachers would report technology usage in their classrooms in the mid- or post-pandemic phases to see if technology plays a more important role in education now that many K-12 schools across the country have been forced to provide hybrid and online instruction. Additionally, a study to investigate if school districts have reallocated funds to provide internet access and computers to students in need could potentially provide some insight as to a way forward to providing high-speed internet access and computers to all K-12 students in the United States.

5.2 Limitations

Only K-12 public schools educators employed in a single Midwestern state submitted responses. A further limitation occurred as survey dissemination depended on school principals to forward a survey hyperlink and purpose of study to their faculty which did permit the researcher to directly contact potential respondents. A further limitation resulted from a limited sample of urban and rural respondents compared to suburban teachers. Though smaller sample populations, these insights provided understanding into educator usage frequencies of technology in a variety of roles.

Appendix 1

ANOVA results

9/22/22, 3:47 PM CTIS Setting

IBM SPSS Web Report - Output23

Oneway

Oneway - ANOVA

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
TEACHING MODES Small group instruction	Between Groups	22.638	2	11.319	5.650	.004
	Within Groups	717.141	358	2.003		
	Total	739.778	360			
Individual instruction	Between Groups	11.894	2	5.947	2.903	.056
	Within Groups	729.354	356	2.049		
	Total	741.248	358			
Cooperative groups	Between Groups	14.557	2	7.279	4.028	.019
	Within Groups	646.966	358	1.807		
	Total	661.524	360			
As a reward	Between Groups	5.170	2	2.585	1.291	.276
	Within Groups	708.651	354	2.002		
	Total	713.821	356			
Independent learning	Between Groups	2.965	2	1.482	.728	.484
	Within Groups	722.848	355	2.036		
	Total	725.813	357			
To tutor	Between Groups	.226	2	.113	.050	.951
	Within Groups	804.662	357	2.254		
	Total	804.889	359			
To promote student-centered learning	Between Groups	.466	2	.233	.122	.885
	Within Groups	678.189	354	1.916		
	Total	678.655	356			
As a research tool for students	Between Groups	4.548	2	2.274	1.243	.290
	Within Groups	651.446	356	1.830		
	Total	655.994	358			
As a problem-solving tool	Between Groups	10.613	2	5.306	2.836	.060
	Within Groups	666.167	356	1.871		
	Total	676.780	358			
As a productivity tool (to create graphs, etc.)	Between Groups	3.197	2	1.598	.781	.459
	Within Groups	724.372	354	2.046		
	Total	727.569	356			
As a classroom presentation tool	Between Groups	9.058	2	4.529	2.174	.115
	Within Groups	737.334	354	2.083		
	Total	746.392	356			
As a classroom communication tool (email, discussions)	Between Groups	25.735	2	12.867	5.433	.005
	Within Groups	840.782	355	2.368		
	Total	866.517	357			

about:blank 1/1

Data availability The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Conflict of interests The author has no conflicts of interest to declare or financial interest to report. The author also has seen and agreed with the contents of the manuscript. The author certifies that the submission is original work and is not under review at any other publication.

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