



Teachers' value beliefs and usage of one-to-one devices for students with dyslexia: A descriptive study

Deborah Anne Irwin¹ · Ismahan Arslan-Ari¹ · William Morris¹

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Abstract

One-to-one devices provide the opportunity for students to develop 21st-century skills, improve academic learning, access information, and increase student independence. This descriptive study explored the value beliefs held by middle school teachers at a school for students with dyslexia (SWD) following the implementation of one-to-one devices and the teachers' technology integration during the instruction of SWD. Data were collected from nine middle school teachers through a survey, classroom observation, and structured interviews. Quantitative findings demonstrated that teachers valued the use of technology in the teaching and learning process and had access to resources and personnel to support technology integration. However, the mean score for the sufficient training for technology integration was found to be lower. The study's qualitative findings revealed (a) one-to-one devices were used as a supplemental resource; (b) technology had both positive and negative impacts, and (c) teachers increased in self-efficacy of technology use within a supportive environment. Based on these findings, extended professional development incorporating 21st-century skills with a focus on the integration of devices into content areas is needed in order to develop the skills and knowledge necessary to incorporate student-centered activities.

Keywords Teachers' value beliefs · Students with dyslexia · One-to-one initiative · Technology integration

✉ Ismahan Arslan-Ari
ismihanarслан@gmail.com; arslanai@mailbox.sc.edu

Deborah Anne Irwin
drdebbieirwin@gmail.com

William Morris
wsm@sc.edu

¹ Educational Studies, College of Education, University of South Carolina, Columbia, SC 29208, USA

1 Introduction

One-to-one device initiatives offer powerful and ubiquitous learning tools for students with dyslexia (SWD) to access information as well as helping to develop and strengthen their academic skills (Adam & Tatnall, 2017; Degirmenci et al., 2020; Ok & Rao, 2017; Xie et al., 2018). Dyslexia is characterized by difficulties in learning to read and write effectively, despite an individual having an average to above average ability to learn (American Psychiatric Association, 2013; International Dyslexia Association, 2020). Since SWD have language processing difficulties and executive functioning weaknesses, both of which can often linger even after intervention, one-to-one devices provide tools and applications that allow them to access learning materials and to increase their academic skills. Furthermore, one-to-one devices offer opportunities for students to develop 21st-century learning skills such as problem-solving, critical thinking, and creativity whilst collaborating with their peers (Adam & Tatnall, 2017; Lowther et al., 2012; Mahoney & Hall, 2017; Varier et al., 2017), as well as improving their academic skills of reading, writing, and mathematics (Lowther et al., 2012; Ok & Rao, 2017; Zheng et al., 2016). The advent of digital technology, and particularly one-to-one devices, has helped students “to be on a level playing field” (Tilton & Hartnett, 2016, p. 84) with their peers and to provide an avenue for literacy enrichment.

Due to the COVID-19 pandemic and the sudden shutdown of face-to-face instruction during the spring 2020 semester in schools, teachers had to implement online learning at very short notice. For those students who did not have a computer at home, the majority of schools in the United States provided an iPad or a Chromebook to their students. The one-to-one device initiative became inevitable due to the educational changes implemented during the pandemic, but then continued even when face-to-face instruction resumed during the fall semester of 2020. Therefore, effective technology integration in K-12 schools has become more crucial than ever.

For effective implementation, it is the teachers’ beliefs and perspectives about technology integration which determines how and to what extent one-to-one devices are implemented into the teaching and learning process. The current literature demonstrated that teachers can utilize their own experience in order to determine the best fit between context, curriculum, and the current available technology (Hamilton, 2017). Therefore, teachers’ voices become valuable in achieving effective technology integration as well as presenting an opportunity for effective professional development. The absence of teachers’ voices may make it more difficult to improve on successful technology usage in the classroom (Williams-Britton et al., 2021). According to the literature, understanding teachers’ beliefs is a critical step in effective technology integration (Ertmer et al., 2012; Ottenbreit-Leftwich et al., 2018; Tondeur et al., 2017). Teachers’ beliefs and perspectives interact with one another, impacting how and to what degree teachers integrate technology into their instructional time (Ertmer et al., 2012; Francom, 2020; Kwon et al., 2019; Lowther et al., 2008; Ottenbreit-Leftwich et al., 2010).

Although teachers are the front-line educators who actually implement one-to-one devices in the classroom, the majority of the current literature has explored

the effectiveness of the one-to-one initiative implementation on students' learning (Harris et al., 2016; Lowther et al., 2012; Selwyn et al., 2017; Zheng et al., 2016). However, teachers' voices about their beliefs and practices also need to be heard in order to ensure such technology integration initiatives are deemed effective (Bice & Tang, 2022). To date, researchers have mostly investigated the teachers' voice in terms of the one-to-one initiative in K-12 schools prior to the COVID-19 pandemic (Heath, 2017; Maffia, 2019), and with fewer studies still (e.g., Bice & Tang, 2022; Ciampa, 2017) having explored technology integration in schools aimed at students with learning disabilities and dyslexia specifically. The current study aimed to address this gap in the literature and to investigate the teachers' value beliefs of technology integration following a one-to-one device initiative implemented during the COVID-19 pandemic at a private middle school for SWD. For this study, value beliefs are the beliefs and or assumptions about students and learning (Kagan, 1992) which directly impact a teacher's use of instructional practices (Richardson, 1996), including technology integration (Ryba & Brown, 2000). Specifically, the study was guided by the following research questions:

- What are the teachers' value beliefs about technology integration in the education of SWD?
- How do the values that teachers hold toward the use of technologies with SWD relate to their integration of one-to-one devices in the classroom?
- How do teachers integrate technology during the instruction of SWD?

2 Literature review

2.1 One-to-one initiatives

One-to-one initiatives, which provide a device for each student's personal use, allow access to technology on a regular basis and thereby make it more likely that teachers will implement technology-based activities (Penuel, 2006; Selwyn et al., 2017; Zheng et al., 2016). While the use of one-to-one devices may be considered ubiquitous due to their mass presence in today's schools (Selwyn et al., 2017), the current initiative was more accurately described as an example of "one-to-one laptop programs, in which all the students in a class, grade level, school, or district are provided computers for use throughout the school day and...at home" (Zheng et al., 2016, p. 1053). Some of the unique features of one-to-one devices, especially Chromebooks, are their relatively low cost, portability, and the ability to facilitate continual access to learning (Evans, 2019; Penuel, 2006; Zheng et al., 2016). Perhaps one of the primary driving forces behind one-to-one initiatives in schools is the desire to build 21st-century learning skills into the curriculum (Adam & Tatnall, 2017; Evans, 2019; Lowther et al., 2012; Mahoney & Hall, 2017; Mucetti, 2017; U.S. Department of Education, 2017). Twenty-first century skills include creativity, critical thinking, collaboration, problem-solving, and innovation using technology in order to become effective learners, both in school and later in the working

environment (Battelle for Kids, 2019; International Society for Technology in Education, 2022). By issuing devices to students for use throughout their day, schools create a ubiquitous environment which provides consistent, equitable access to learning for all students (Mucetti, 2017) and therefore, makes it easier for students to develop 21st-century digital literacy skills needed for their future (Freeman et al., 2017; Selwyn et al., 2017; U.S. Department of Education, 2017).

2.2 Benefits of one-to-one devices

The one-to-one initiative has been implemented widely in K-12 schools around the world and has been reported to offer considerable advantages. While the results in terms of academic achievement have been mixed according to numerous studies (Delgado et al., 2015; Harper & Milman, 2016; Parks & Tortorelli, 2021; Williams & Larwin, 2016), some research has shown positive gains and noted that such devices offer opportunities for personalized learning (Bippert & Harmon, 2017; Clariana, 2009; Zheng et al., 2016).

2.2.1 Academic achievement

One-to-one devices have been found to positively impact on students' written expression, literacy skills, and math achievement. First, they have been shown to have a positive impact on writing skills including content, organization, and style (Donagrich, 2019; Zheng et al., 2016). Sessions et al. (2016) reported that written expression skills increased and writing products were more sequential and detailed after having used an iPad during writing activities. Steiner (2017) provided rich narratives on one male dyslexic student's use of a Chromebook for writing activities and who gained in writing ability confidence having used a Chromebook whilst learning. In a study by Williams and Larwin (2016), although reading achievement results showed mixed results, teachers still expressed benefits in using one-to-one devices as well as the flexibility that digital reading materials offered. Anderson and Putman (2019) found special education teachers were able to use built-in formative assessment as a way to track student progress. Delgado et al. (2015), and Hull and Duch (2019) found the use of technology resulted in modest effect size gains in mathematical achievement.

2.2.2 Individualized instruction

One-to-one devices allow teachers to better differentiate instruction and individualize instruction by using a variety of learning materials (Bippert & Harmon, 2017; Harper & Milman, 2016; McKnight et al., 2016). Teachers reported that they were able to differentiate learning material for all students, especially for those with learning needs (Bippert & Harmon, 2017; McKnight et al., 2016). Special education teachers found that one-to-one devices allowed them to individualize instruction and present lessons in a variety of formats to meet individual student needs (Anderson & Putman, 2019).

2.2.3 Ownership of learning

When students have the tools to access information, they are inclined to take ownership of their learning. Due to the availability of one-to-one devices, the majority of students can now access knowledge for personal and academic use (Clariana, 2009; Gherardi, 2017). Ertmer et al. (2012) found that students took ownership of their learning as teachers provided more student-centered activities and thereby placed greater responsibility upon them. One-to-one devices offer the means to individualize instruction, enhance academic achievement, and to allow students to take ownership of their learning (Ertmer et al., 2012; Gherardi, 2017; Ottenbreit-Leftwich et al., 2010).

2.3 One-to-one devices as assistive technology tools

One-to-one devices can be used as a means to assist students in accessing the curriculum (Floyd et al., 2020) and learning materials (Adam & Tatnall, 2017; Mahoney & Hall, 2017; Shaywitz et al., 2008; Svensson et al., 2019). Assistive technology is compensatory in nature, allowing SWD to access, organize, and present information so that their weaknesses in reading, written expression, and listening comprehension are minimized (Adam & Tatnall, 2017; Shaywitz et al., 2008). Assistive technology was originally established as part of United States federal legislation under the Individuals with Disabilities Education Act (IDEA) (2004) and later supported through the Assistive Technology Act (2004). For public schools, federal aid provides assistive technology to students which includes “any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve functional capabilities of individuals with disabilities” (Assistive Technology Act, 2004, Pub. L. No. 108–364). Since that time, assistive technology has served to level the playing field (Tilton & Hartnett, 2016). For those with a mild level of disability, such as dyslexia, audio recordings can provide access to printed material to support those with poor decoding or reading comprehension abilities (Shaywitz et al., 2008; Svensson et al., 2019). Text-to-speech applications, such as Dragon Speak Naturally, ReadWrite, and Natural Reader (Ok & Rao, 2017), allow users to convert text, such as docs, PDFs, and web pages, to speech. In a similar fashion, speech-to-text applications can aid those with organization, written language, handwriting, and spelling difficulties (Mahoney & Hall, 2017; Ok & Rao, 2017; Shaywitz et al., 2008). Also, the benefits of text-to-speech and speech-to-text applications for students with reading disabilities are listed as promoting the inclusion of the students into the general education and enhancing the students’ motivation and interest to learn (Nordström et al., 2019).

2.4 Barriers to technology integration

The implementation of one-to-one devices can sometimes be impeded by external and internal barriers. First order barriers are institutional in nature and extrinsic

from the teacher (Ertmer et al., 2012; Vongkulluksn et al., 2018). They are areas which are outside of a teacher's direct control, yet impact the teacher's resources, schedule, and support. In addition to lacking resources, teachers mentioned the lack of sufficient time to plan effectively, explore new software, and manage classroom devices (Bippert & Harmon, 2017; Delgado et al., 2015; Francom, 2020; Tang et al., 2021). Administrative and peer support also play significant roles in one-to-one device use (Francom, 2020; Inan & Lowther, 2010; Kopcha, 2010; Ottenbreit-Leftwich et al., 2018).

Second order barriers, which are intrinsic to teachers, are harder to affect since they are personal in nature (Ertmer, 1999; Vongkulluksn et al., 2018). Second order barriers refer to the beliefs, or suppositions, held with regards to the teaching and learning process. Teachers' beliefs regarding teaching and the usefulness of technology in teaching can impact upon the degree of effective technology integration (Ertmer & Newby, 2013; Ertmer et al., 2012; Ottenbreit-Leftwich et al., 2010). Teachers tend to provide instruction either from a teacher-centered pedagogy, which is often lecture-based, or from a student-centered, constructivist, pedagogy (Applefield et al., 2001; Dole et al., 2016; Ertmer & Newby, 2013). Teachers align their use of technology based on their belief about teaching and learning (Ertmer et al., 2012; Vongkulluksn et al., 2018). Those teachers who are more traditional in nature are therefore less likely to integrate technology as effectively as those with a constructivist pedagogy (Applefield et al., 2001; Ertmer, 2005; Ertmer & Newby, 2013). Beliefs, though, are more difficult to affect, requiring considerable time and training prior to any successful classroom technology implementation (An & Reigeluth, 2011; Ertmer, 2005; Kopcha, 2010).

2.5 Teachers' value beliefs of technology integration

Value beliefs are the "perceived importance of particular goals and choices" (Ottenbreit-Leftwich et al., 2010, p. 1322). In relation to technology, value beliefs are the "teacher's perceptions of technology's influence on student learning and achievement and impact on classroom instruction and learning" (Inan & Lowther, 2010, p. 142). If teachers believe that technology will have a positive impact on learning and student achievement, then their value belief is considered high compared to a teacher who is uncertain or negative to its potential effectiveness. It is possible, however, for teachers to have a strong, espoused belief about the role of technology in classroom instruction yet fail to implement it (Chaaban & Moloney, 2016; Ertmer et al., 2012). An espoused belief is one that is held but not acted upon (Ertmer et al., 2012). Espoused beliefs can occur due to not fully understanding a student-centered pedagogy, lack of time to plan and prepare an effective technology integration, or a lack of knowledge on how to integrate technology within their content. These teachers will, however, often still use technology for low-level activities such as drill-and-practice, presentation of videos and slides, or for research purposes. Whilst low-level technology integration may supplement and enrich the learning environment, they are not considered transformative in nature (Ertmer et al., 2012) and does not require critical thinking on the part of the student.

Teachers with a strong student-centered belief pedagogy are more likely to integrate technology into their instruction. Harper and Milman (2016) found that technology is considered most useful when combined with cooperative learning and student-centered instructional strategies. This is perhaps due to student-centered instruction being considered best practice in modern-day classroom education (Lowther et al., 2012; Ottenbreit-Leftwich et al., 2010). Teachers' beliefs about the importance of technology integration on student learning results in the most significant change in how they implement technology into their teaching practices (Ertmer et al., 2012). Teachers with a strong student-centered, constructivist pedagogy often integrate technology using high-level activities (Ertmer, 2005; US DOE, 2017). High-level activities are also known as high-yield instructional strategies, since they are specifically designed to increase student achievement (Williams & Larwin, 2016). Student-centered activities include project-based learning, collaboration, and individual inquiry (Ertmer et al., 2012; Lowther et al., 2008; Williams & Larwin, 2016). Through student-centered activities, technology can be used to organize, evaluate, and create forms of communication to share with others within authentic contexts (Larson & Miller, 2011). Baylor and Ritchie (2002) found the use of one-to-one devices in higher-order, constructivist activities can lead to the development of higher-order thinking skills among students.

3 Method

The current descriptive study used a convergent parallel mixed-methods design so as to utilize both quantitative and qualitative forms of data (Creswell & Creswell, 2018) in order to better understand the value beliefs of teachers following a one-to-one device initiative held by teachers in the fifth to eighth grades at a school for SWD. Mixed-methods studies have been shown to be beneficial when studying a heterogeneous special education population with diverse learning implications (Collins et al., 2006). A convergent parallel mixed-methods design was used in the current research in order to place equal emphasis on the quantitative and qualitative data, with neither form influencing either the collection or interpretation of the other (Onwuegbuzie & Leech, 2006). Each set of data was analyzed independently, and then later merged for the final data analysis and theme development.

3.1 Setting

The study was conducted at a private middle school located in the southeastern United States which provides Orton-Gillingham (OG) instruction for SWD. The OG method of reading and writing involves direct, systematic instruction of reading and writing. OG is a systematic, research-based approach to teaching phonemic principles needed for reading decoding and spelling (Peavler & Rooney, 2019; Stebbings & Kline, 2020). OG tutoring is considered an important element which all students at the school receive to assist them in overcoming the issues they face through their dyslexia. In total, the school has 65 students and 19 teachers. All of the teachers are

certified by the Academy of Orton-Gillingham. The school itself is housed in a spacious building with flexible seating options and equipped with Apple TVs, Chromebooks, and interactive whiteboards. A one-to-one device program was initiated by the school's administration during the fall semester of 2020, i.e., during the COVID-19 pandemic.

3.2 Participants

Of the school's 19 teachers, nine (seven females, two males) agreed to take part in the study. Their ages ranged from 21 to over 50 years old. Half of the teachers had worked at the school for less than five years. Two of the participants were tutorial teachers, whilst seven were content area teachers. The demographics, along with each participant's pseudonym, is presented in Table 1.

3.3 Data collection

After the Institutional Review Board granted approval for the proposed study and the participants had each signed a consent form, data were collected through a *Value Beliefs of Technology Integration* (VBTI) survey, classroom observation, and semi-structured individual interviews. The VBTI survey was used to measure the teachers' beliefs and perceptions. The survey items were adapted from constructs used in the study by Inan and Lowther (2010), as well as Battelle for Kids (2019), and International Society for Technology in Education (2022), along with a survey by Lowther and Ross (2000) and Sterbinsky and Ross (2003). The applied survey contained three constructs which each impact upon technology integration (Inan & Lowther, 2010; Lowther et al., 2008): teaching/learning, self-efficacy, and barriers. The participant teachers were each asked to rate their level of agreement on 14 statements using a 5-point, Likert-type scale that ranged from (1) *strongly disagree* to (5) *strongly agree*.

The content of the VBTI was independently validated by two experts. Additional quantitative data came from classroom observations used to gather information about how the teachers integrated technology into the classroom, as well as how and

Table 1 Study participants' pseudonym and demographics ($n=9$)

Pseudonym	Gender	Age range (years)	Years teaching	Years at school	Teaching content area
April	Female	21–30	6–10	1–5	English Language Arts
Cathy	Female	41–50	6–10	1–5	Social Studies
Connie	Female	51+	21+	1–5	Tutorial
Eric	Male	31–40	16–20	16–20	Science
Evelyn	Female	41–50	21+	1–5	Math
Gail	Female	51+	16–20	6–10	Tutorial
Natalie	Female	51+	21+	16–20	Literature
Peter	Male	41–50	16–20	16–20	Drama
Rachel	Female	31–40	6–10	1–5	English Language Arts

for what purpose the students interacted with the technology. Seven 50-min classroom observation sessions were conducted based on availability and the teachers' consent. An observation form (see Appendix 1) was created based on the research questions and the *School Observation Measurement* (Ross et al., n.d.). The form was broken into two broad categories to separately record technology usage by teachers and by their students. The teacher section of the form was subdivided into classroom procedures, instructional tools, and instructional strategies, whilst the student section was subdivided into classroom procedures, accessibility, grouping, technology usage, and technology purpose. In addition to recording observational data for each section, the researcher also added additional comments and anecdotal memos about the technology usage observed which provided qualitative data. The added rich descriptive information provided greater understanding of the teachers' beliefs related to technology use (Mertens, 1998). The observation form was also reviewed by two experts prior to its application to ensure its content validity.

Following the classroom observation sessions, semi-structured interviews were conducted with the participants to obtain further insight into their value beliefs and the ways in which technology had been integrated into their classroom instruction. All of the participants were invited to participate in the semi-structured interviews, with eight having consented to participate. Each interview was conducted virtually on Zoom and lasted approximately 45 min. Each interview was recorded with the participants' prior consent.

3.4 Data analysis

Mean and standard deviations were calculated for the VBTI survey data and for each construct. Frequency counts during the observation sessions provided insight as to how and the extent to which teachers and students used technology during lessons.

The inductive analysis (Saldaña, 2021) was used to analyze the qualitative data from the semi-structured interviews and comments section of the observation form manually. First, pseudonyms were assigned to each participant at the outset of the study and were used as identifiers in the transcriptions to ensure the confidentiality of the participants. Inductive analysis included two cycles of coding which consisted of multiple rounds. The first coding cycle began with reflecting upon what the participant was saying or doing in a line-by-line manner, generating codes based on the context rather than a predetermined list (Creswell & Creswell, 2018). Initial and in-vivo coding was used in the first cycle. The initial coding breaks content down by ideas and actions (Charmaz, 2005; Mertens, 1998) and is useful for coding interview data (Saldaña, 2021). During the second round of the first cycle coding, in vivo or direct comments from the participants to capture their exact words and meanings was used. Based on the meaning, the initial generated codes were carefully reviewed and then sorted according to type and group.

In the second cycle of coding, the codes were organized into logical groupings using pattern coding. Two rounds of coding were applied since pattern coding is seen as beneficial in creating meaningful groupings, especially for large amounts of collected data (Saldaña, 2021). For any code which could not be easily connected to

the participant's meaning, the original transcript was referred back to. This was particularly applicable for in-vivo codes since the meaning of words such as "forced" or "less reluctant" were unclear without connection to the original context. Whilst reviewing the categories, the focus was on achieving alignment within the groups, as well as appropriately naming categories. For instance, the category of "nature of dyslexics" was changed to "characteristics of dyslexia." After the categories were created in the first round, we began to cluster them in order to reveal themes and assertions, which were then used to explain relationships and to summarize the collected data (Ryan & Bernard, 2000). The themes were revised several times prior to being finalized. Throughout the qualitative data analysis, several peer debriefing sessions were conducted with a fellow researcher from the educational technology field. In order to ensure the study's rigor and trustworthiness, member checking, peer debriefing, triangulation, and rich descriptions were all utilized (Creswell & Creswell, 2018; Mertler, 2017).

4 Findings

4.1 Quantitative findings

4.1.1 VBTI survey

Overall, the teachers agreed that technology plays an important role in teaching and learning, although they differed on agreeing to what degree ($M=3.94$, $SD=0.91$). Descriptive statistics were reported for each subscale, as can be seen in Appendix 2.

4.1.2 Role of technology for teaching/learning

The teachers agreed that technology positively impacts upon student learning ($M=3.87$, $SD=0.97$). They expressed the strongest agreement on Item 2, "I believe the use of devices in the classroom prepares students for future application of technology" ($M=4.78$, $SD=0.44$). Even though most of the teachers agreed technology played a beneficial role in the teaching and learning process, items related to promoting higher-level thinking ($M=3.00$, $SD=1.22$), enhancing the motivation to learn ($M=3.22$, $SD=1.30$), and enabling students to be more creative ($M=3.11$, $SD=0.93$) received the lowest mean scores.

4.1.3 Self-efficacy

The overall mean score for the self-efficacy section was 4.06, with a standard deviation of 0.88. Based on the teachers' ratings ($M=4.00$, $SD=0.71$), the teachers believe that they possess the technological skills necessary to integrate technology into their teaching. However, not all of the participant teachers felt confident in selecting technology to meet the required curriculum standards ($M=4.11$, $SD=1.05$).

4.1.4 Barriers

The survey section on barriers revealed a higher mean score than for self-efficacy, but less of a variance ($M = 4.22$, $SD = 0.69$) which indicated a greater agreement among the participants. While the teachers believed that they had access to adequate resources and personnel to support technology integration ($M = 4.67$, $SD = 0.71$), the mean score for sufficient training for technology integration was shown to be lower ($M = 3.78$, $SD = 0.67$).

4.1.5 Classroom observations

According to the classroom observations, the participant teachers and their students used the various technological tools available for a variety of purposes (see Appendix 3). The most frequently used instructional tool ($n = 7$) was a one-to-one device (i.e., laptop), which was used by all seven of the teachers observed in the study. The teachers also used Apple TVs to project slides, documents, and media to their students, whilst one teacher used a document camera. The teachers were most often engaged with the whole group, with direct instruction then employed for the students to work independently. Collaborative learning took place in three of the observed classes, and four of the classes also had students join the classroom virtually. In one such class, the teacher created a hybrid group using a one-to-one device to project the virtual student within the group. One of the observations was during a tutorial session in which the teacher was working one-on-one with a student. The tutorial setting, as well as the majority of the observed classroom instruction, focused on direct instruction.

Students primarily used their laptops to complete assignments independently. In two settings, the students used Web 2.0 applications to practice certain skills. In one class, the students used speech-to-text to assist in writing, whilst in another, the students used a web-based reading portal. On three occasions, the students used devices to work collaboratively with their peers. Two of the students used devices for drill and practice so as to help develop their automaticity of certain skills. In one class, the students were engaged in more of a creative, student-centered activity by writing original scripts. The only time a student used a mobile phone was to take a picture of his homework, having mistakenly forgotten the paper agenda.

4.2 Qualitative findings

Using inductive analysis, three themes emerged from the analyzed data; (1) Technology as a supplement, (2) Impact of technology, and (3) Increase in self-efficacy. In this section, the themes and categories with sample teacher quotes are presented.

4.2.1 Technology as a supplement

Based on the interview data, the teachers placed a high value on their role to bring expertise in regard to understanding the nature of SWD and instructional strategies to meet their specific needs. This theme contains the categories of (a) Role of the teacher, (b) Role of technology, and (c) Reason for including technology.

Role of the teacher The teachers in this study held a teacher-centered paradigm which placed emphasis on direct instruction in which teachers have the primary role in the delivery of instruction (Ertmer et al., 2012). One participant, Peter [the drama teacher], referred to teachers as “the master organizer.” He stated, “You’re not communicating to students; you’re communicating to *your* students. And that’s what the teacher has to bring to integrate technology.” The teachers, unlike the technology itself, were able to engage in the ongoing assessment of their students and adjust the lessons accordingly. Many of the teachers mentioned having individualized lessons and shifted the focus to the mastery of the material rather than content coverage. Gail [the tutorial teacher] mentioned having decided what and how much material to present to her students based on their needs, responses, and social/emotional wellbeing each day.

Role of technology The teachers stressed that technology was a resource and should be used as a supplemental tool during instruction. For example, in math class, Evelyn [the math teacher] supported the use of one-to-one devices depending on the purpose. She felt calculators were appropriate for more complex calculations once a student knew the basic processes. In her interview, Evelyn [the math teacher] mentioned several times that technology should be used as a supplemental tool and not simply as a replacement for the teacher. While Rachel [the English language arts teacher] spoke of the benefits of technology and one-to-one devices for students, she also stated that the use of such devices could be a “double-edged sword.” Teachers thought that the devices could be beneficial to many students, but they seemed to find added distraction when using them. Even for those students who benefited from assistive technology available on devices, Cathy [the social studies teacher] noted, “For a lot of the students, I wouldn’t say it has a primary role; I would say it’s more secondary. It’s enhancement.”

Reason for including technology While the participants viewed technology as a supplemental resource, they expressed its importance in preparing students for the future. The teachers stated that students needed to be prepared for using technology in the future in order to keep pace with their mainstream peers. On this, Gail [the tutorial teacher] said, “I think it [technology] keeps up with the fast pace of the world that we live in, that the students have to...are immersed in”.

4.2.2 Impact of technology

The teachers believed that the benefits of technology outweighed any concerns. This theme includes the categories of (a) Impact of assistive technology tools, (b) Positive impact of one-to-one devices, and (c) Negative impact of one-to-one devices.

Impact of assistive technology tools The characteristics of dyslexia can have a negative emotional and cognitive impact on students. According to the interviews, the teachers seemed especially aware and sensitive to the emotional impact that dyslexia could have on students despite their cognitive ability. The teachers noted both their students' difficulty in processing language, the differences in their processing speeds, and how it impacted on the students. They mentioned that their students used a variety of assistive technology tools which helped them to overcome certain learning and emotional challenges.

Assistive technology tools can increase the rate at which students gather information as well as express their understanding. Peter [the drama teacher] commented, "Basically, any fluency increase is a massive, massive gain for them." Several participants noted that assistive technology levels the playing field for SWD. In doing so, students were more able to compete with their peers. On this, Gail [the tutorial teacher] said, "I think it [assistive technology tools] helps them be...competitive with other students in the school system....So this [assistive technology tools] helps them keep pace and have the same opportunities that they might otherwise miss." Cathy [the social studies teacher] made a similar comment, stating, "When they learn about the [assistive technology] tools and how to use them, it...it keeps them right in line with...with their peers." Being able to compete with their peers helps to build self-confidence for SWD, which is often negatively affected.

Of all the assistive technology tools available, the teachers stated that their students regularly used speech-to-text and text-to-speech in order to access learning materials due to the positive impact on their learning, and they encouraged their students to use them. Connie [the tutorial teacher] mentioned that text-to-speech was a valuable tool for students to use so that they could listen to what they had written and self-edit their own work. Eric [the science teacher] noted that text-to-speech allowed students to access grade-level texts, providing them with richer language and more advanced concepts than they would otherwise have read on their own. By being able to access these materials, the teachers found that their students had become more engaged in the class. Cathy [the social studies teacher] said, "That's, that's massive, because it allows them to engage in my classroom, whereas before, they probably would have just tuned me [the teacher] out and shut me down, and I generally wouldn't have been able to reach them at all." The speech-to-text and text-to-speech tools therefore impact not only the content, but also the learning environment as well.

The students also reportedly used built-in tools such as spell check, dictionary, thesaurus, and grammar check when editing their work. Connie [the tutorial teacher] stated, "Spell check and grammar check really helps level the playing field," and spell check had been beneficial in reducing the cognitive load during writing. Connie [the tutorial teacher] also thought that her students were more willing to write and

had written longer paragraphs while using a combination of speech-to-text and editing tools. Similarly, Cathy [the social studies teacher] said, “They [spell check and speech-to-text] really are almost academic lifesavers for some of these kids, and offer such intense value.” Also, Gail [the tutorial teacher] had noticed that her students were using richer vocabulary when they were able to access tools such as dictionary or thesaurus as they would incorporate better word choices in their paragraph writing.

Positive impact of one-to-one devices The teachers described numerous benefits of one-to-one devices including enabling the continuance of education during the COVID-19 pandemic, affording support for individualized instruction, enhancing academic skills, monitoring student progress, promoting ownership of learning, and helping to enhance students’ self-esteem and confidence. The teachers expressed the ease of use and benefits that Chromebook tools offered and the positive impact of devices on providing differentiated and personalized instruction. Cathy [the social studies teacher] said, “I cannot individualize lesson plans for every single student in my classroom, and, yet almost every kid needs an individualized lesson plan whether they’re dyslexic or not.” Evelyn [the math teacher] used *IXL*, an interactive online learning platform, to differentiate lessons for her students in math classes, while Rachel [the English language arts teacher] used *CommonLit* for reading passages. The integration of devices in the classroom was found to have had a positive impact on the students’ academic skills.

The one-to-one devices and several apps, as well as Google Doc tools, were considered beneficial in developing students’ writing abilities. The teachers noted that one-to-one devices were used to develop the automaticity of skills, aid learning retention, and assisted in concept formation. The teachers used several apps, such as *Reflex Math*, *CommonLit*, *WordWall*, and *IXL*, to develop their students’ fluency and automaticity of skills. In her interview, Gail [the tutorial teacher] stated, “...we do activities for repetition, and for helping...getting, you know, moving them towards certain concepts, so they’re solid.” Fluency is a core OG principle which is considered foundational for learning more complex material (Gillingham & Stillman, 1999).

In this study, the availability of devices allowed for decentralized instruction to take place and for students to become more actively engaged in the learning process. Peter [the drama teacher] mentioned his students being able to navigate through documents and videos at their own pace. In science classes, Eric [the science teacher] noted, “They can see the relationships a lot better when they’re the ones [manipulating variables] instead of just being taught that a warm-current warms up the air nearby. You know, for them to actually discover that on their own.” The students were also noted as being more willing to engage in academic learning of their own initiative. Rachel [the English language arts teacher] stated that her students were asking to read on their own, whilst Connie [the tutorial teacher] noted that when learning activities were game-like, the students would ask to practice their skills.

There were times, though, when the students needed to be encouraged or reminded to take ownership of their learning. Some SWD could become too reliant on their teachers and other adults as informational sources. Gail [the tutorial teacher] stated that sometimes her students would ask the meaning of a word or for

a better word choice. She said, “They just get caught in a pattern of asking us so it’s a way we can move them away from being dependent on one person.” Evelyn [the math teacher] gave an analogy of visiting a doctor by explaining, “It’s kind of like going to the doctor and saying, ‘Okay, so what hurts on me? Hmm...’ and the Doctor going, ‘Yeah, no, *you* tell me.’ In many ways this is a revelation to them.” Evelyn [the math teacher] stated that once students realized they were the best ones to understand their own thinking, they had taken more ownership of their learning.

One-to-one devices can be used to increase students’ self-esteem and confidence. The teachers mentioned seeing increases in their students’ self-esteem when they worked collaboratively to support their teachers in the use of technology. Cathy [the social studies teacher] noted that the students were very technologically savvy and that both she and Rachel [the English language arts teacher] noted that the students were able to troubleshoot problems when technology was being used in the classroom. She stated, “They offer as much instruction to us as their teachers as we do for them on their content.” Coupled with the confidence students gained academically from using the devices, they also showed increased self-esteem through supporting others.

Negative impact of one-to-one devices Some teachers talked of certain negative aspects of technology usage including its tendency to be too general, limiting social interaction and verbal communication, promoting an overreliance on such devices, a form of learning distraction, and technical difficulties. Regarding the lack of intentionality certain technology and software possess, Peter [the drama teacher] stated that similar to workbooks, technology can be too broad and general to address individual student needs.

The school, as well as OG (Gillingham & Stillman, 1999), placed significant value on social interactions and oral communication. Peter [the drama teacher] noted that the continual use of devices was a “danger to that [oral communication] part of our goal.” The administration and faculty recognized the need for social interactions for middle school students, especially those with dyslexia, during the period of the COVID-19 pandemic which created additional stress for middle school students (Crosby et al., 2020). Rachel [the English language arts teacher] said she tried not to overuse devices; instead, she sought ways to incorporate meaningful conversation into her lessons. In order to address feelings of isolation experienced by students during digital learning, especially during the COVID-19 pandemic, the school made the decision to utilize hybrid learning so that students who were isolated due to COVID were still able to attend classes, albeit virtually. The hybrid model seemed to help lessen the isolation online education presented.

The teachers noted their concern that students are at risk of becoming passive learners by letting computers do their work for them. Cathy [the social studies teacher] stated, “It makes them lazy. They basically have kind of reached a point where they’re willing to let the device do things for them that they should be working on themselves.” She went on to say that students will even question why they should have to do something that a computer can do for them. Teachers needed to encourage students to develop and utilize literacy and memory skills instead of relying too much upon technological solutions.

Several teachers noted experiencing Internet access connectivity issues, although the administration and technology staff provided the necessary resources. Also noted by all of the participants was the distraction factor that devices posed for students. The teachers mentioned that students were often viewing websites or videos when they should have been completing assignments. Cathy [the social studies teacher] said that while some students were conscientious in their use of devices, others saw it as “an extra play toy.”

4.2.3 Increase in self-efficacy

The teachers expressed having increased self-efficacy in technology usage within a supportive environment. In this study, four teachers indicated that they felt comfortable using technology on a regular basis prior to the one-to-one initiative; two teachers specifically mentioned that they did not experience a learning curve when they transitioned to one-to-one devices or online learning. This strong level of self-efficacy was perhaps in part due to those teachers having had access to devices on a regular basis prior to the one-to-one initiative. However, others had limited levels of self-efficacy prior to the COVID-19 shutdown and the one-to-one initiative. The teachers talked of receiving a strong level of support from the school administration and their peers during the transition to online learning and the one-to-one initiative. On this, Evelyn [the math teacher] noted, “I felt very supported. And at least if they couldn’t help, I felt like they were behind me and with me, supportive and understanding, sympathetic and empathetic.” Initially, the academic dean and one of the teachers had created numerous shared resources. However, over time, as the teachers gained skills and increased in self-efficacy, they were able to modify and customize the shared resources to fit the needs of their students.

5 Discussion

The purpose of this descriptive research study was to examine and explain the value beliefs of technology integration following one-to-one devices and how they were being used with middle school SWD. This section presents a discussion of the research questions, limitations, and implications.

5.1 Teachers’ value beliefs about technology integration

Teachers implement one-to-one devices in their instruction based on their value beliefs. According to the results of the VBTI survey, the teachers placed a high value on the use of technology in the teaching and learning process. Of the survey’s three subcategories, overall, the teachers felt least strongly about the *role of technology for teaching/learning*. The responses varied as to whether the participants strongly disagreed or strongly agreed on elements related to the integration of technology such as creative thinking, higher-order thinking skills, motivation, collaboration, future technology use, and accessibility tools. It is noteworthy

to mention that items related to promoting higher-level thinking, enhancing the motivation to learn, and enabling students to be more creative received the lowest mean scores which fell between (3) Neutral and (4) Agree, although the teachers agreed on the benefits of technology in the teaching and learning. This might indicate that teachers were not certain enough that technology can support teaching and learning process for deep learning. While immediate feedback provided by technology could be beneficial to students whilst learning (Ertmer & Newby, 2013; Green & Johnson, 2010; Varier et al., 2017), it was not specific enough in determining how best to meet students' needs and organize learning material. The participants noted this importance by describing teachers as “the master organizers,” who are able to effectively communicate to their students based on experience and knowledge. Such expertise comes from teachers able to understand the needs of the individual and through mediating learning.

In the interviews, the teachers emphasize the primary role of the teacher over that of technology for their students, which is contrary to most literature related to technology integration. Ertmer (1999) stated that a primary barrier to technology integration was teacher-directed activities. Likewise, Ertmer et al. (2012), Ottenbreit-Leftwich et al. (2010), and Varier et al. (2017) found that effective technology integration led to a constructivist paradigm which integrated 21st-century skills such as collaboration and creativity. It may be that students without a learning disability have a greater propensity for self-directed, discovery-based learning compared to SWD.

Based on the survey results and interview comments, the participants agreed that technology helped to prepare students for their future life. The participants agreed or strongly agreed that the use of devices in the classroom aided in preparing students for future technology application. Comments made by the participants during interviews further supported the idea that technology use prepared students for future work-related skills. One-to-one devices can be effective tools in developing 21st-century skills, as they provide tools and access to knowledge for problem solving (Battelle for Kids, 2019; International Society for Technology in Education, 2022).

Technology, especially one-to-one devices, offers learning tools which assist students in accessing learning material. In this study, assistive technology included tools and applications which allowed for the access, organization, and presentation of information (Adam & Tatnall, 2017; Dawson et al., 2019; Shaywitz et al., 2008). In the VBTI survey, teachers had a high level of agreement regarding the learning benefit of assistive technologies. The teachers employed adjectives such as *massive*, *lifesavers*, and *huge* when referring to the benefit of assistive technology tools and noted that devices helped to ensure that SWD are “on a level playing field,” as noted by Tilton and Hartnett (2016, p. 84). The teachers mentioned the benefits of assistive technology in helping to relieve the physical and mental fatigue of SWD. Tools such as speech-to-text and text-to-speech supports those with poor reading and written expression by assisting them in accessing higher-level text and effectively communicating their ideas, which were findings aligned with the existing literature (Adam & Tatnall, 2017; Mahoney & Hall, 2017). In addition, students reportedly took more ownership of their learning and actively engaged in selecting tools which benefited them the most, helped to monitor their understanding, and practice their weaker

academic skills. Collectively, such actions resulted in increased confidence and self-efficacy among the students.

Although the teachers reported various benefits of using technology in the classroom, they also stressed that certain barriers existed to effective technology integration. According to the survey, although they had access to the necessary resources and support, their rating for sufficient professional training being offered prior to the one-to-one initiative was lower. Insufficient training on technology integration is one of the most important barriers to the effective technology integration in education (Hew & Brush, 2007; Kopcha, 2012; Pittman & Gaines, 2015).

5.2 Teachers' value beliefs impact on technology integration

The one-to-one initiative in the study setting was primarily an administrative decision. Both administrative and teachers' decisions are involved in technology integration. Some decisions, such as the type of device and platform to be used, were made by the administration and IT department of the participant school. However, the ways in which one-to-one devices were utilized within the curriculum were made solely by the teachers. Research has shown that teachers integrate technology and devices based on their teaching paradigm, ability to overcome barriers, level of self-efficacy skills, and understanding of how to utilize devices within the curriculum (Ertmer et al., 2012; Inan & Lowther, 2010; Ottenbreit-Leftwich et al., 2018; Zheng et al., 2016).

The teachers in the current study made decisions on a daily basis as to if and how they integrated technology into their instruction. The teachers utilized a greater variety of Web 2.0 applications to assess the reading skills of their students, to engage the students, and to help build their language fluency. As teachers gained confidence in using devices, they were more likely to have students engage in high-level integration. High-level activities are designed to increase student achievement (Williams & Larwin, 2016) by having students more actively engaged in the learning process. One-to-one devices allow for both students and their teachers to collaborate simultaneously, and for assignments and projects to then be shared with others (Larson & Miller, 2011).

Value belief is often connected to the training and background of teachers (Ertmer et al., 2012). The teachers in the current study had received specialized training in multisensory, explicit instruction based on the principles of OG designed to address the language processing weaknesses of SWD (Gillingham & Stillman, 1999). OG principles include systematic, sequential, and logical dissemination of information in order to build fluency, comprehension, and communication skills. These same principles were intertwined into the instruction and curriculum delivered at the participant school, including technology integration. Teachers in different content areas used and expressed the benefits of technology integration differently. For instance, the science teacher felt technology allowed students to access higher level content and engage in higher level thinking skills and exploration of concepts. The math and tutorial teachers used technology as extension activities following direct instruction. While the English and drama teacher had students accessing accessibility tools

for longer writing assignments. As a result, the technology integration was primarily teacher-centered and associated with direct instruction. This finding aligns with other research (Bice & Tang, 2022) conducted in elementary schools for SWD where OG principles were followed. Also, Tondeur et al. (2017) stressed that external variables such as school features can have an influence on teachers' beliefs.

It is not uncommon for teachers, especially those with low self-efficacy in the use of technology, to utilize technology to replace teacher-directed activities. Low-level technology integration includes drill and practice and also independent student work (U.S. Department of Education, 2003). Ertmer (2005) stated that low-level integration occurs where teachers hold the belief that they should be the primary source of information and instruction in the classroom. Bice and Tang (2022) found that novice teachers used drill and practice exercises as well as direct instruction, which are teacher-centered traits and believed that technology is a supplementary tool to be used to support instruction in lessons. In this study, the teachers could be considered as novices since they had not previously integrated technology in their lessons on a regular basis and had very little experience, prior to the one-to-one initiative having been implemented at their school.

In the VBTI survey, the teachers agreed overall that one-to-one devices can positively impact academic performance. They mentioned the positive impact that one-to-one devices can have on students' reading, math, and written expression skills. Although drill and practice activities are considered a low-level skill (Ertmer et al., 2012), repetition which leads to automaticity is an important element of OG instruction. Several teachers used web-based activities such as *WordWall*, *Quizizz*, and *Kahoot!* to reinforce and assess the curriculum they taught. For example, Gail [the tutorial teacher] noted in her interview that she often customized activities on *WordWall* for students to practice specific skills being taught, both for reading and for spelling.

5.3 Methods of technology integration

The participant teachers and students mainly used the one-to-one devices and various assistive technology tools. While the participants agreed overall that the devices played an important role in the teaching and learning process based on the survey results, their responses differed according to the degree and ways that technology was integrated during instruction. Based on observations, the teachers demonstrated enacted and espoused beliefs.

Within the scope of technology integration, teachers enact beliefs when their teaching strategies include high-level, collaborative student-centered activities (Ertmer et al., 2012; Lowther et al., 2008; Williams & Larwin, 2016). Two of the seven teachers used devices in high-level, collaborative student-centered activities. Both teachers had high self-efficacy and used devices on a regular basis. One of the teachers had students collaborating on an original script using a template they had created to guide planning and decision making. The other teacher had students work individually and in small groups to analyze meteorological data and discuss their findings. The teacher also included a virtual student by having her displayed within

a hybrid group. Both teachers seemed very comfortable teaching within a hybrid setting and in engaging their students in collaborative activities.

With technology integration, espoused beliefs tend to lead to low levels of technology integration (An & Reigeluth, 2011; Ottenbreit-Leftwich et al., 2010). Low-level integration includes activities such as word processing, drill and practice, watching videos, and conducting research (Dole et al., 2016; Ertmer et al., 2012). The other teachers, while they espoused the importance of technology integration, used devices in low-level activities including word processing, drill and practice, and watching videos. Only one teacher, who had low self-efficacy and did not place a high value on the role of technology, did not ask her students to use devices at all. Instead, the students took handwritten notes while she projected her handwritten notes using a document camera.

6 Implications

The purpose of this descriptive study was to describe how teachers of middle school SWD implemented technology following a one-to-one device initiative and to examine their value beliefs of technology integration in order to inform practice. First, extensive planning is paramount before the implementation of one-to-one initiatives. Minimizing barriers such as infrastructure (Bippert & Harmon, 2017; Keane & Keane, 2017) and planning time (An & Reigeluth, 2011) have been shown to increase technology usage. Therefore, besides the provision of technology and technical support alone, ongoing professional development should be provided to teachers that focuses on effective technology integration that incorporates the learning of 21st-century skills. Such professional development training can assist teachers in preparing their students for future technology use by being focused on creative, higher-order thinking skills (Casner-Lotto & Benner, 2006; Ertmer et al., 2012) and, over time, helping to shift the teaching and learning paradigm to a more student-centered focus (Ertmer et al., 2012). Also, such training should focus on technology integration into multisensory instruction.

7 Limitations and future research

As with any research study, there are limitations which impact upon the study's findings and how they may be applied. First, the study was conducted during a period impacted by COVID-19 protocols, necessitating virtual interviews and observations. This limited the ability of observing body language and whether students were on task when using their devices. In addition, a small sample size limited the ability to establish reliability of the survey. Second, data were collected from only nine teachers. Small sample size limits the generalizability of the findings; therefore, the results should be interpreted judiciously. Future studies could be conducted with larger sample size after establishing the reliability of the survey instrument. Last, the teachers were observed once one semester after the one-to-one initiative had started.

Future studies could be designed to observe teachers before and several points following the commencement of a one-to-one initiative.

Appendix 1: Technology integration observation tool

Teacher’s Name _____ Grade Level _____ Content Area _____
 Date _____ Start Time _____ End Time _____

Directions: After completing the information above, mark the technology item(s) observed in each category within a single class visit.

Teacher’s usage			Student’s usage		
Classroom procedures			Classroom procedures		
Attendance			Recording assignments		
Assignment submission			Digital notebook		
Communication			Communication		
Desktop	Document		Text-to-speech		Dictionary/Thesaurus
Laptop	Presentation/Slides		Speech-to-text		Magnifier
Projector	Simulations		Highlighting tool		Other:
Interactive whiteboard	Video				
A/V conference	Web 2.0		Grouping		
Mobile device			Independent		Small group
			Pair		Whole class
			Technology Usage		
Direct Instruction			Writing		Presentation/slides
Project based learning			Audio recording		Video recording
Cooperative learning			Technology purpose		
			Drill/Practice		Research
			Collaboration		Creative
			Assessment		

Appendix 2: Descriptive statistics

Descriptive Statistics for Role of Technology for Teaching/Learning (N = 9)

Role of technology for teaching/learning items	<i>M</i>	<i>SD</i>
1. I believe technology is an important tool in the teaching–learning process.	3.89	1.27
2. I believe the use of devices in the classroom prepares students for future application of technology.	4.78	0.44
3. I believe one-to-one devices positively impact the learning environment.	4.00	1.00
4. I believe one-to-one devices can be used effectively to build academic skills.	4.11	0.93
5. I believe technology can serve as assistive devices for learning for students with disabilities.	4.67	0.50
6. I believe technology assists students in learning complex concepts.	3.67	1.22
7. I believe students are more motivated to learn when using one-to-one devices.	3.22	1.22
8. I believe one-to-one devices can promote higher-level thinking in students.	3.00	1.22
9. I believe one-to-one devices enable students to be more creative during the learning process.	3.11	0.93
10. I believe one-to-one devices enable students to collaborate with peers.	4.22	0.83

Descriptive Statistics for Self-Efficacy (N = 9)

Self-efficacy items	<i>M</i>	<i>SD</i>
1. I believe I have the technology skills needed to utilize one-to-one devices effectively in my teaching.	4.00	0.71
2. I believe I am able to select technology tools which best align with the curriculum standards.	4.11	1.05

Descriptive Statistics for Barriers (N = 9)

Barrier items	<i>M</i>	<i>SD</i>
1. I believe I was provided with sufficient training to effectively use my technology resources for instruction.	3.78	0.67
2. I believe I have access to resources and personnel to support technology integration.	4.67	0.71

Appendix 3: Technology integration observation frequencies

	Type of use	Frequency
<i>Teacher's usage</i>		
Classroom procedures	Attendance	0
	Assignment Submission	0
Instructional tool	Communication	1
	Desktop	1
	Laptop	6
	Projector/Apple TV	5
	Interactive whiteboard	0
	A/V conference – Google Meet	4
	Document camera	1
	Mobile device	1
	Mic	1
	Document	3
	Presentation/Slides	4
	Video	2
	Web 2.0	2
Instructional strategy	Direct instruction	6
	Project based learning	0
	Cooperative learning	2
<i>Student usage</i>		
Classroom procedures	Recording assignments	1
	Digital notebook	0
	Communication	0
Accessibility	Text-to-speech	1
	Speech-to-text	1
	Highlighting tool	2
	Dictionary/Thesaurus	0
	Magnifier	0
	Other—spellcheck	1
Grouping	Independent	5
	Pair	2
	Small group	1
	Whole class	5
	Hybrid group	1

	Type of use	Frequency
Technology usage	Reading	2
	Writing	5
	Audio recording	0
	Math	0
	Presentation/slides	0
	Video recording	0
Technology purpose	Drill/Practice	3
	Collaboration	2
	Assessment	2
	Research	0
	Creative	1
	Unknown	3

Data availability statement The data collected in the current study are available from the corresponding author on reasonable request.

Declarations

Ethical approval This research was approved by the ethics committee of the authors' institution.

Informed consent Participants' consent was received prior to their participation in this research.

Competing interest The authors declare that they have no conflict of interest.

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