Evaluation of the Tech4Schools Scheme

29th September 2023

Authored by

Prof. Lucy Betts, Adam Potter, Prof. Thom Baguley,

Dr. Sarah Buglass, Dr. Gayle Dillon, & Dr. Lucy Justice

NTU Psychology

Nottingham Trent University

Contents

Acknowledgements 4
Introduction 5
Background: Digital inequalities in education 6
The Tech4Schools scheme 7
The Technology Acceptance Model 8
The Technology acceptance model and the current evaluation 14
Technology use as a predictor of digital skills and school engagement 15
Methods 16
General approach 16
Theory of Change 17
Theory of Change Problem Statement 18
Surveys with learners 20
Method 20
Study design 20
Participants 20
Attrition 23
Measures 25
Procedure 31
Missing data approach 32
Survey with Learners Results 32
Scale properties 32
Home learning environment 33
Home academic and non-academic intended device use 33
Academic use 35
Technology Acceptance Model scale 36
Digital self-efficacy scale 37
Value 38
Taking part 38
Descriptive statistics across waves 41
Exploring differences between learners at baseline 44
Primary language spoken at home 44
Correlations among variables at each timepoint 47
Technology acceptance model 60
Technology use a predictor of digital skills and school engagement 69
Summary of results from learners 82
Online surveys with parents 86
Method 86
Study design 86
Participants 86

Study materials ... 86
Procedure ... 87
Results ... 87
Summary of results from parents ... 88
Online focus groups and online surveys with teachers ... 89
Methods ... 89
Study design ... 89
Participants ... 89
Study materials ... 89
Procedure ... 90
Analysis ... 90
Results ... 91
Difficulties before the scheme ... 93
Benefits of the scheme ... 97
Limitations of the scheme ... 103
Summary of teacher data ... 106
Case studies ... 108
Case study 1: Enhancing learners' digital skills and engagement ... 108
Case study 2: Access to the device reduced strain on families ... 108
Case study 3: Access to the device enabling learners to support their family ... 108
Case Study 4: The impact of insecure housing ... 109
Discussion ... 109
Integration of findings across learners, parents, and teachers ... 109
Limitations and implications for future evaluations ... 110
Conclusions ... 111
References ... 113

Acknowledgements

This evaluation was funded by the Digital Poverty Alliance. The research team would like to thank Dr. Keelan Meade and Fiona Wong for all of the support during the project. The team would also like to thank all of those who took the time to participate in this research and the various schools involved for supporting data collection and the evaluation.

Introduction

The role and importance of digital technologies for supporting learning in educational settings has been clearly identified such that "*learning facilitated and supported by digital technologies, is seen as an essential part of formal education"* (Harju et al., 2019, p. 388). The use of digital technology in school affords learners with a range of learning opportunities and can support their development (Mädamürk et al., 2021). Digital technology also can "*diversify and enrich teaching in schools"* (Harju et al., 2019, p. 389). However, it is important to acknowledge that while digital technology can support learning, it can also provide opportunities to avoid learning activities with the impact of digital technology yielding small but heterogenous results for academic functioning (Hietajärvi er al., 2022). Indeed, research with university students has reported that digital technology can also distract or divert their attention away from their studies (Selwyn, 2016). Relatedly, Bergdahl et al. (2020) reported that while high performing secondary age students found it easier to concentrate when using digital technologies than average or low performing students, engaging in unauthorised multi-tasking using digital technology during lessons was associated with lower grades. However, it has been argued that digital technology is central to education; in particular, with regards to addressing the quality education strand of the United Nations' sustainable development 2030 agenda (Haleem et al. 2022).

Differences have been reported in learners' preference to engage with digital technology at school. For example, Mädamürk et al. (2021) reported that 15- to 16-year-olds from Finland who had either average or high achievement goals also wanted to complete more digitally mediated schoolwork. Further, Mädamürk et al. also reported gender differences relating to preferences for engaging with digital technology at school. Specifically, the boys in Mädamürk et al.'s sample reported that they had higher digital learning preferences and higher wish for digital schoolwork than the girls.

Background: Digital inequalities in education

Although the role of digital technology in education is regarded as central (Haleem et al., 2022), the challenges associated with digital inequalities cannot be overlooked. Digital inequalities have previously been conceptualised as the digital divide pertaining to whether or not individuals have access to information and communication technologies (ICT, van Dijk, 2017). However, Elena-Bucea et al. (2021) argues that the digital divide is "*volatile*" and that the "*continuous evolution of ICT has given rise to different digital divides*" (p. 1008). These digital divides have been considered to be first order (i.e., associated with the access to technology or not), second order (i.e., associated with ICT usage and proficiency), and third order (i.e., understanding the impact of offline equalities; Coleman, 2021; Elena-Bucea et al., 2021; van Dijk, 2020). van Dijk (2020) argues that growing social inequalities are likely to be reflected in growing digital inequality. Talaee and Noroozi (2019) also argue that we should consider the inequalities between what they term "*connected users*". This inequality is set against the backdrop of the requirements for connectivity and devices being far greater than previously (Allman, 2022) with the pace of digitisation of society increasing because of the Covid-19 pandemic (British Academy, 2022). Consequently, as Faith and Beecher (2022) note "*digital access is now essential for modern life – and thus digital poverty could be seen as analogous to fuel or food poverty"* (p. 3)

Relating to children, this may translate to "*the integral question within the digital divide debate now, is the inequalities among children in taking up the technology opportunities and overcoming the potential risks"* (Talaee & Noroozi, 2019 p. 32). Children's ability to capitalise on these online learning opportunities relies on their digital connectivity and these opportunities are affected by the family's income (Andrew et al., 2020). Further, Coleman (2021) argues that at the start of the pandemic, children from families where the main earner was in less skilled and lower paid work were more likely to experience digital exclusion

when schools switched to remote learning. Moreover, teachers reported that students' lack of engagement with remote learning opportunities during covid-19 lockdowns was due to students not having access to devices and adequate internet access (Montacute & Cullinane, 2021). There was also a perception that the Department for Education's provision of devices for disadvantaged pupils during the pandemic was inadequate (Faith & Beecher, 2022). Although having the ability to access a device is important, Holmes and Burgess (2022) also describe how for those experiencing digital poverty, because of their living circumstances, they may not have appropriate workspaces for a device.

Due to the impacts of digital poverty, a range of interventions and schemes have been developed to try to reduce these inequalities. For example, providing free equipment or improving broadband connectivity, and supporting digital skills (Dafoulas et al., 2022). This report provides an evaluation of one such scheme in the UK: Tech4Schools.

The Tech4Schools scheme

The Tech4Schools scheme is "*designed to tackle the issue of digital poverty and digital access"* for students in the UK (Anderson, 2022). As part of the scheme, Teach First identified 20 schools from disadvantaged communities across the UK who received £18,000 funding for devices and associated peripherals for students to use in school and at home (Anderson, 2022). The scheme represents a collaboration between Amazon, the Learning Foundation, In Kind Direct, and Teach First and represents a mechanism to reduce digital inequalities.

What follows is the report of an independent evaluation of the Tech4Schools scheme. Given that the Tech4Schools scheme is based on the premise of students receiving a device to support their learning, the Technology Acceptance Model (Davis, 1986, 1989) will provide the theoretical framework for this evaluation.

The Technology Acceptance Model

The Technology Acceptance Model (TAM, Davis, 1986, 1989) was originally proposed to provide a theoretical framework to understand user acceptance of technology and assist designers and implementors to evaluate systems before they were implemented. The TAM includes variables that attempt to explain the behavioural intentions to use technology and includes both direct and indirect factors. The indirect factors include the perceived usefulness of the technology, the perceived ease of use, and the user's attitudes towards technology. Davis (1989) argued that both perceived usefulness and perceived ease of use influence an individual's propensity to engage with technology. Perceived usefulness was defined as "*the degree to which a person believes that using a particular system would enhance his or her job performance"* (Davis, 1989, p 320). Davis argued that the decision around whether to use technology relates to the benefits for an individual, with acceptance of technology more likely when it was perceived as being very useful. However, Davis argued that the likelihood with which someone would engage with technology is also influenced by their perceptions of how easy it will be to use the technology. Perceived ease of use was defined as "*the degree to which a person believes that using a particular system would be free of effort"* (Davis, 1989, p 320). Therefore, technology that was perceived to be easier to use would be more likely to be accepted by users.

The TAM also acknowledges the importance of behavioural intention to engage in the behaviour of using the technology impacts actual technology use (Lee et al., 2003). Behavioural intention is predicted by both perceived usefulness and perceived ease of use (see Figure 1).

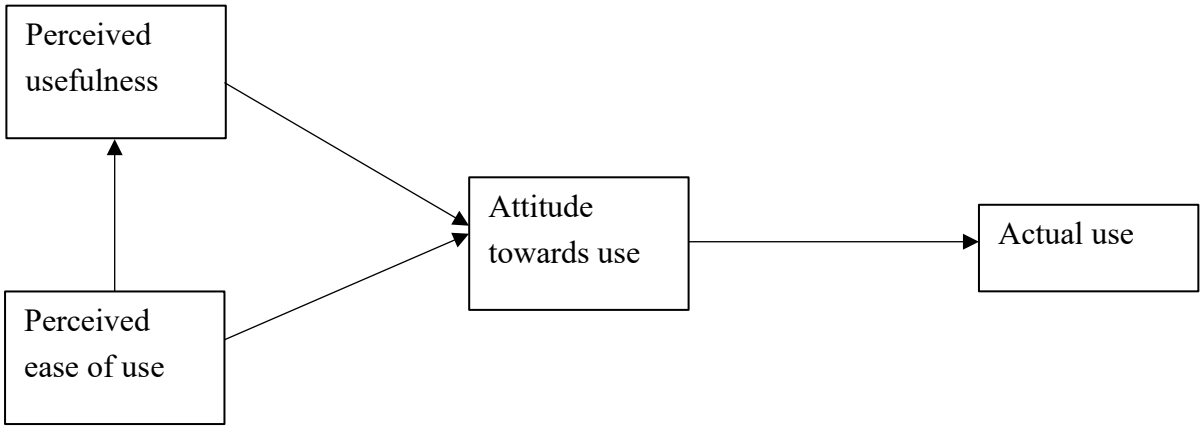

Figure 1. The original TAM adapted from Marangunić and Granić. (2015, p.86)

The original TAM has been extended and developed to integrate a range of factors including: (a) external predictors, (b) factors from other theories, (c) contextual factors, and (d) usage measures (Marangunić & Granić, 2015, see Figure 2).

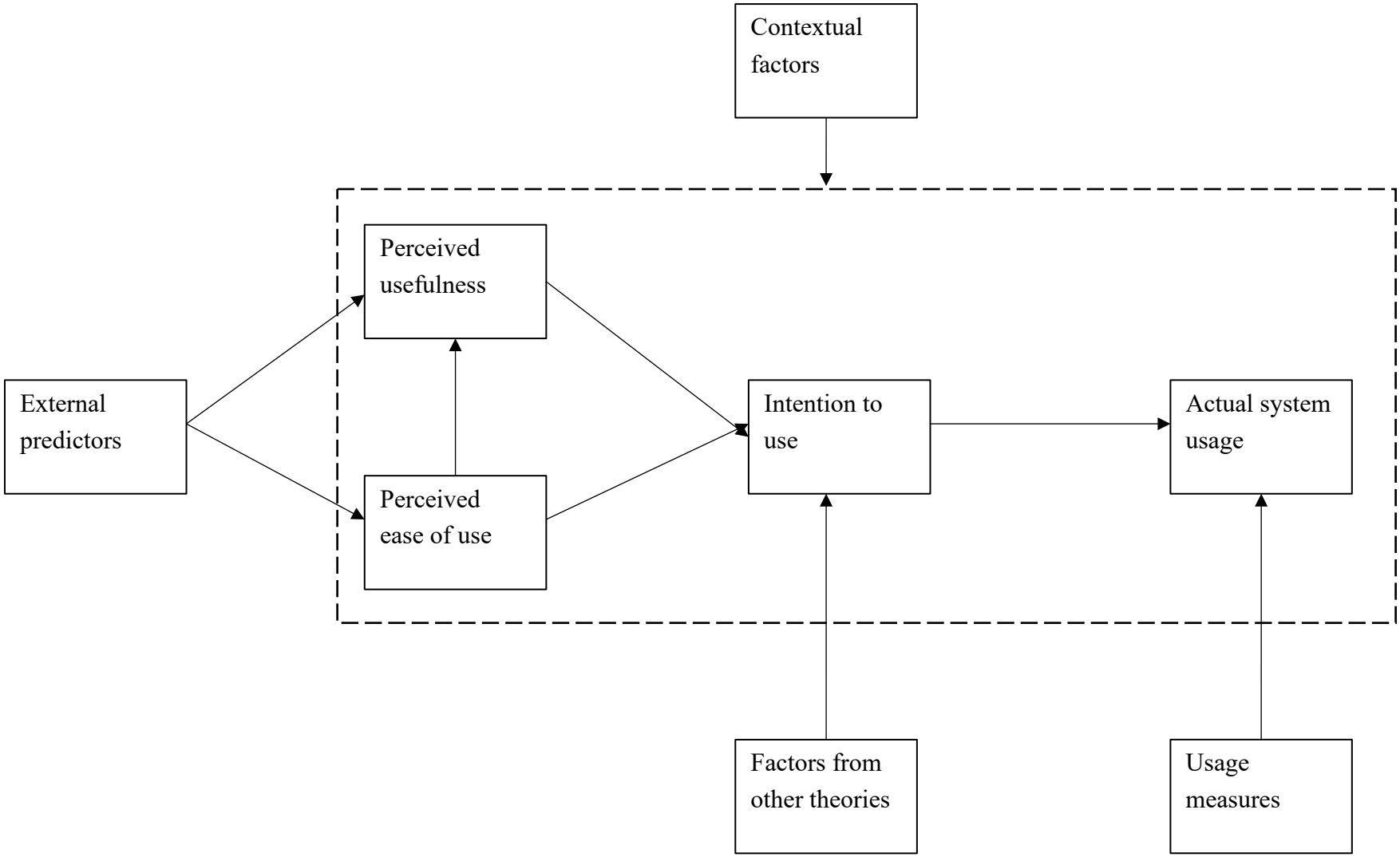

Figure 2. The development of the TAM based on Marangunić and Granić's (2015, p 90) interpretation of King and He (2006)

According to Marangunić and Granić. (2015), external predictors pertain to variables that could predict perceived usefulness and perceived ease of use such as self-efficacy. Factors from other theories are those that enhance the predictive validity of the TAM and could include subjective norms, expectations, or user participation. Contextual factors pertain to variables that could have a moderating effect on the model such as gender or culture. Usage measures include attitudes towards the technology, usage perception, and actual usage of the technology.

The TAM has been reported to predict acceptance of a range of technology in various contexts (Lee et al., 2003) including healthcare (Holden & Karsh, 2010), education (Granić, & Marangunić, 2019), and consumer behaviour (Shukla et al., 2018). Consequently, the TAM is regarded as a crucial model for exploring the predictors of use of technology (Marangunić & Granić, 2015). In terms of the applicability of the TAM to education settings, Scherer et al. (2019) note that "*one model though has dominated the research landscape – the Technology Acceptance Model"* (p. 14). Following a systematic review of 71 studies, Granić and Marangunić (2019) concluded that the perceived ease of use and perceived usefulness variables from the TAM are consistent predictors of learning with technology. Moreover, greater usefulness predicted elevated levels of satisfaction and greater usefulness and satisfaction with learning positively predicted intention to use (Granić & Marangunić 2019). However, it is important to acknowledge that not all relationships reported in the TAM have been identified in previous research (King & He, 2006).

Although the TAM has been widely applied to technology use in the education domain, the majority of this research has been conducted in university settings (Granić & Marangunić, 2019). However, the TAM has been used as the theoretical framework for exploring tablet computer use with Chinese learners aged 11-13 (Zheng & Li, 2020), Turkish secondary school students (Çukurbaşı et al., 2016; Gorhan et al., 2014), learners aged 14-15 from

Brunei (Sahadani & Salleh, 2014), Italian high school students aged 14-18 (Cacciamani et al., 2018), German middle school students (Ifenthaler & Schweinbenz, 2016), Malaysian high school students (Elyazgi et al., 2014), and American high school students (Arndt & Peterson, 2018). The TAM has also been applied as the theoretical framework for exploring use of desktop PCs with Taiwanese learners aged 15 (Lin, 2014) and e-readers with Malaysian third grade learners (Hsiao & Chen, 2015).

The relationships outlined in the TAM have been identified in children's use of technology for learning. For example, self-efficacy positively predicted perceived usefulness, perceived ease of use and perceived usefulness, perceived ease of use and task-technology fit predicted intention to learn with eReaders (Hsiao & Chen, 2015). Further, self-efficacy, technology anxiety, and family support positively predicted perceived usefulness and perceived ease of use of tablets for a single lesson (Zheng & Li, 2020). Zheng and Li also reported that family support and perceived usefulness positively predicted attitude towards the device and intent to use and perceived ease of use positively predicted perceived usefulness. Relatedly, encouragement from parents, teachers, and peers along with availability of tablets, and self-efficacy predicted intent to use (Sahadani & Salleh, 2014). Family support and infrastructure support also predict use of tablets for learning (Cacciamani et al., 2018). Therefore, together these studies highlight the importance of social influence as a complementary factor within the TAM. However, Ifenthaler and Schweinbenz (2016) reported that there was no relationship between social influence or attitude and behavioural intention.

Although the majority of studies have found relationships in support of the TAM predictions, some studies have reported negative relationships between variables within the TAM. For example, Çukurbaşı et al. (2016) reported that tablet ownership was associated with more negative views of technology (assessed as lower perceived usefulness, perceived ease of use, attitude, and intent). Çukurbaşı et al. argued that these findings were indicative

of the stage of the intervention that they were evaluating with the tablets being introduced to learners before the full programme was complete meaning that there was a lack of elearning availability. Cacciamani et al. (2018) also reported that perceived ease of use did not predict any variables within the TAM and explained this finding by arguing that the learners were very familiar and comfortable with technology. Variations in perceived usefulness, perceived ease of use, and satisfaction with device have been reported according to device type, with learners who used a tablet reporting higher levels than those who used a desktop PC (Lin, 2014). Perceived usefulness and perceived ease of use also reduced with age, although this could be attributed to changes in the requirements of what is required of the devices for the more advanced curriculum (Arndt & Peterson, 2018).

When focusing on applying the TAM to school settings, it is important to acknowledge that it does not include a description of the professional knowledge that teachers require to integrate technology into classrooms (Scherer et al., 2019). However, following their meta-analysis of 114 empirical studies with data from over 34000 teachers, Scherer et al. (2019) argue that the TAM is applicable to understand pre- and in-service teachers use of technology with educational settings. Various studies have also explored how the TAM can apply to teachers' use of technology within educational settings including with language teachers (in the United Arab Emirates, Abrezeq et al., 2020), primary school teachers (in Morocco, Rahali et al., 2022), secondary school teachers (in Kuwait, Aldekheel et al., 2022, AlQenaei et al., 2021; Malaysia, Moses et al., 2013; and South Africa, Diseko et al., 2022), pre-service teachers (in Türkiye, Cuhadar, 2014). However, as the current scheme focused on learners' technology use, these findings with teachers are not described in detail.

The Technology acceptance model and the current evaluation

In the current evaluation, the technology acceptance model was used as a theoretical basis to explore the factors that predicted the children's intent to use the device at baseline. Two versions of the model were proposed: (1) exploring the extent to which children's home learning environment, age, digital self-efficacy, influenced the TAM predictors of perceived ease of use, perceived usefulness, perceived satisfaction, and intent to use (Figure 3) and (2) an extended version of the model outlined in Figure 3 to include school engagement (Figure 4).

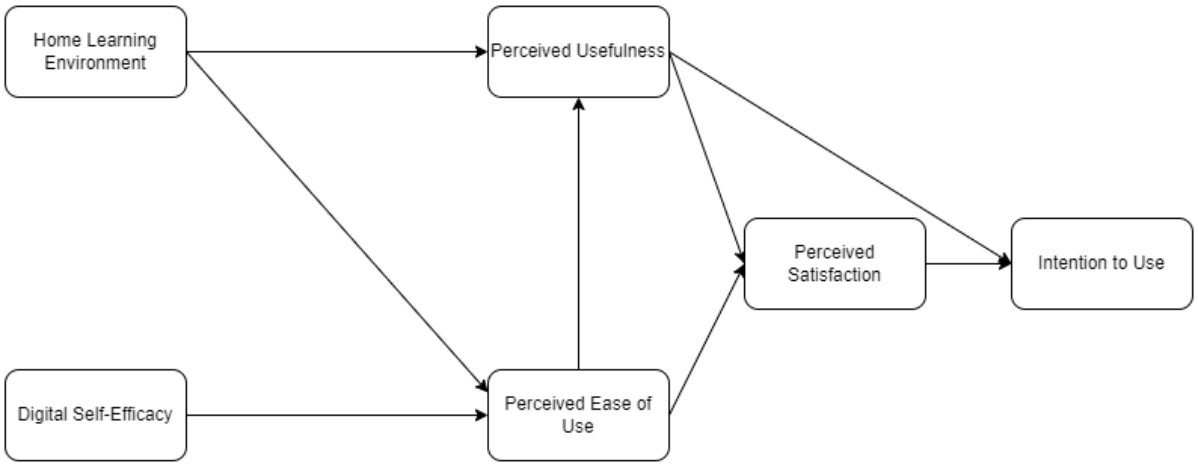

Figure 3. The first model explored as part of the evaluation.

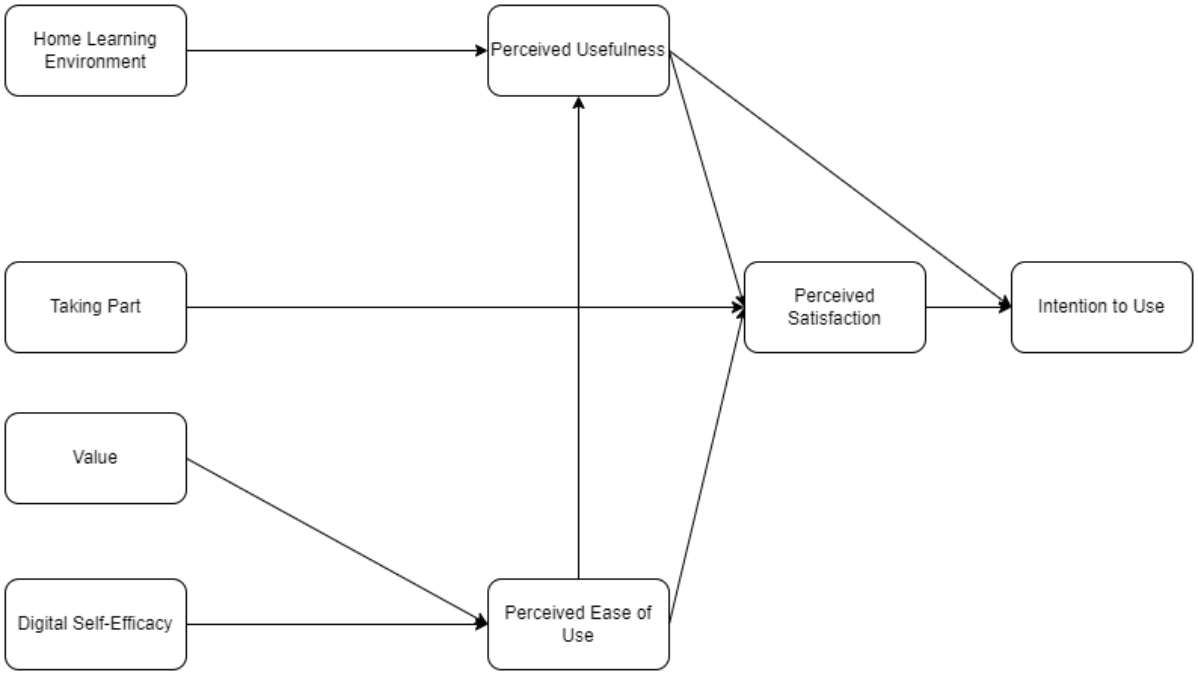

Figure 4. The second model explored as part of the evaluation.

Technology use as a predictor of digital skills and school engagement

Digital self-efficacy has been identified as central for engaging with digital technologies (Ulfert-Blank & Schmidt, 2022) and online learning (Prior et al., 2016). Moreover, digital self-efficacy can enable learners to deal with technological problems and facilitate lifelong learning (Bonanati & Buhl, 2022). There is evidence that technology use can positively influence an individual's self-concept (Jackson et al., 2010). Further, research with secondary age students reports that iPad use increases their self-efficacy over time (Perry & Steck, 2015). Similarly, engaging in digital creative challenges has also been shown to enhance children's creative self-efficacy (Atwood-Blaine et al., 2019). Relatedly, confidence with technology has also been associated with supporting learning (Houghman et al., 2018) while low levels of confidence are reported to be a barrier to online learning (Ewig & Cooper, 2021). Consequently, given the importance of digital self-efficacy for fostering

lifelong learning (Bonanati & Buhl, 2022) and the importance of technology confidence for removing barriers to learning with technology (Ewig & Cooper, 2021), as part of the current evaluation we explored whether learners' digital self-efficacy and confidence with technology changed overtime.

School engagement represents a multifaceted construct that includes affective, behavioural, and cognitive dimensions (Jimerson et al., 2003). School engagement has been described as "*an antidote to low achievement, high levels of student boredom and dissatisfaction, and the high dropout in urban areas"* (Fredricks et al., 2005, p.305). Although Fredericks et al. (2004) reports that school engagement remains stable over time, it is acknowledged that digital technology can enhance children's engagement with school (Lo & Miller, 2020; Rizk & Davies, 2021). Further, teachers have described how using digital technology can increase students' confidence and assist with personalisation of learning (Ventouris et al., 2021). Relatedly, research with learners reports that Finnish students aged 12-13 reported that they wanted to use digital technology more and that digital technology use promoted school engagement. Consequently, as part of the current evaluation we also explored whether learners' school engagement changed over time following involvement in the Tech4School scheme.

Methods

General approach

The evaluation design was guided by a theory of change that was developed at the start of the project. The evaluation adopted a convergent parallel mixed methods design which involved: (1) online surveys with learners, (2) online surveys with parents, and (3) online focus groups and online surveys with teachers. Each strand of data collection and analysis was conducted independently, and the results brought together for the overall integration. A

mixed method design was used because such an approach affords benefits for knowledge and validity (Schoonenboom & Johnson, 2017). Specifically, using mixed methods enabled: (1) triangulation of results through the different approaches to provide corroboration of findings and (2) complementarity of results through facilitating elaboration of results from each strand of data collection. The focus group schedules and online surveys for teachers and parents enabled participants to discuss outcomes associated with the intervention and included prompts associated with the questionnaires used for the learner survey to allow meaningful integration between methods (Plano Clark, 2019).

Theory of Change

To understand the potential impact of the Tech4Schools intervention, we have outlined various short- and long-term changes, along with the mechanisms through which this might occur. This has been captured in a Theory of Change. A Theory of Change represents best practice for outlining intervention development (Michie et al., 2008). This methodology describes how the activities outlined in the Tech4Schools intervention can bring about long-term goals by specifying a logical sequence of interrelated short- and mid-term outcomes that must be in place for the goals to occur (Weiss, 1995). For example, the provision of technology equipment may not on its own directly impact educational outcomes but may instead be mediated by short- and mid-term changes in learners' sense of digital self-efficacy and/or confidence with technology. This theory driven approach will allow us to monitor and evaluate the pathways to impact, enabling us to understand and quantify the pathways through which change occurs.

Theory of Change Problem Statement

The Digital Poverty Alliance have identified physical access to be a core problem associated with digital inequalities in school-aged children. Lack of physical access can be manifested in three ways:

- lack of technology to support learning in school
- lack of technology for digital inclusion outside of school
- lack of reliable and sufficient internet access

The Tech4Schools scheme is "*designed to tackle the issue of digital poverty and digital access"* for students in the UK (Anderson, 2022) by providing technology for children to use for school and home use, and where necessary support access to stable internet connectivity. Figure 5 outlines the planned intervention activities, the change mechanisms through which we expect school-aged students to move, the short-term outcomes we expect to see during the timescale of the NTU evaluation and the long-term outcomes expected in the subsequent school evaluations.

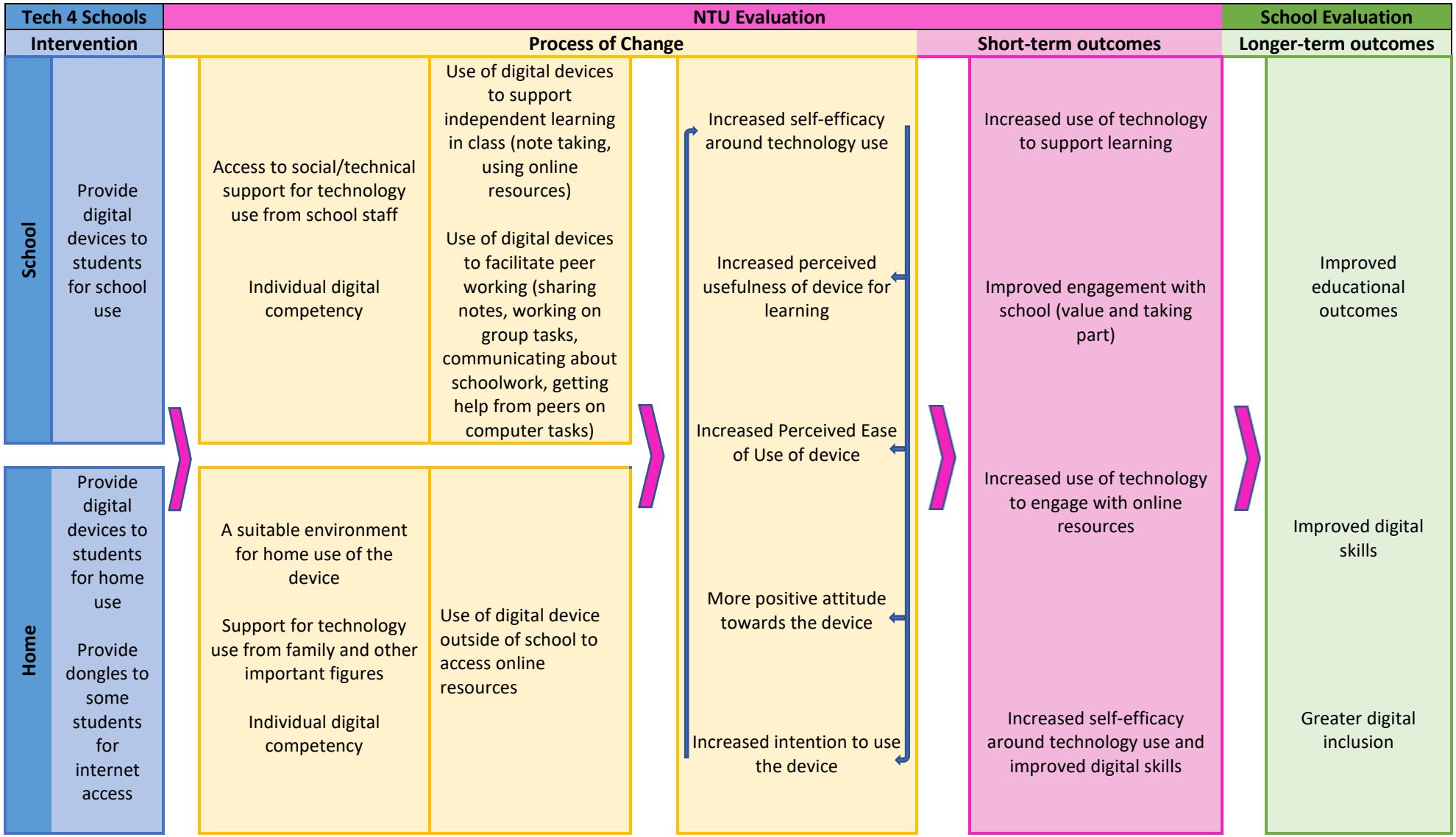

Figure 5. Theory of Change for the Tech4Schools scheme

Surveys with learners

Method

Study design

A four-wave longitudinal design was adopted to enable changes from baseline to be examined and to allow the impact of the devices to be explored over time. Baseline data collection occurred shortly before or just after schools received the devices (typically in January 2023). The following three waves of data collection then took place approximately every 4-6 weeks after baseline. There was some variation in the timing between waves due to school holidays and the national teacher strikes. Each school was provided with a list of randomly generated IDs to allocate to each student, to allow responses to be linked across waves. As two schools joined the Tech4Schools scheme later in the school year, they only received the first three waves.

Participants

Initially, all schools participating in the Tech4Schools programme were invited to participate in the evaluation through emails distributed by the Digital Poverty Alliance. Head teacher consent was gained from 11 schools, although learners from 9 schools went on to participate in the evaluation. At baseline participants were 209 (95 female, 106 male, 4 non-binary, 4 not recorded) year 7 to 13 students from 9 schools participating in the Tech4Schools scheme. The majority of the learners reported that they primarily spoke English at home (n = 135, 64.90%) and that they had received a laptop (n = 194, 93.27%) rather than a tablet (n = 8, 3.85%). Table 1 provides details of how the sample recruited from each school matched school data in terms of gender and language primarily spoken at home. From comparing the data in Table 1, it seems that school 2 opted to give the devices to children who primarily spoke another language at home.

Table 1. Comparison of the baseline sample characteristics against school data.

	Male		Female		Other First Language	
	BL	School data	BL	School data	BL	School data
School 1	48.0%	51.4%	48.0%	48.6%	38.5%	52.2%
School 2	62.5%	54.8%	37.5%	45.2%	100.0%	32.6%
School 3	72.2%	55.2%	27.8%	44.8%	33.3%	65.8%
School 5	63.2%	46.6%	36.8%	53.5%	5.6%	34.0%
School 6	64.3%	50.6%	35.7%	49.4%	46.4%	71.9%
School 7	60.9%	59.8%	34.8%	40.2%	36.4%	76.9%
School 9	0.0%	0.0%	100.0%	100.0%	29.6%	69.0%
School 10	57.1%	49.7%	14.3%	50.3%	0.0%	5.5%
School 11	63.6%	56.5%	36.4%	43.5%	20.0%	26.5%

The evaluation design and sample characteristics for each timepoint is shown in Figure 6.

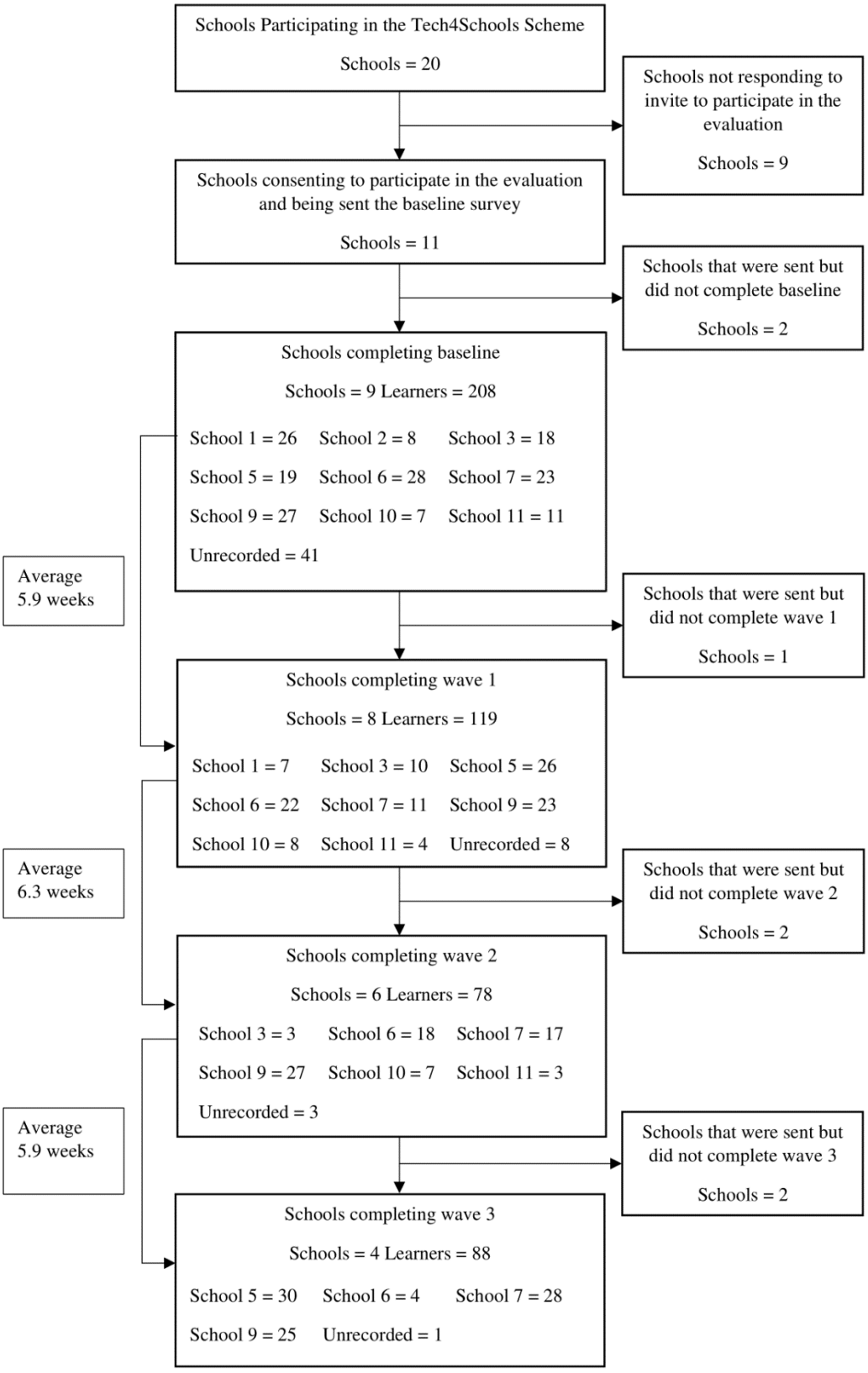

Figure 6. Details of the evaluation design for learners and sample at each timepoint

Attrition

Due to the variation in schools that participated at baseline and in subsequent waves, a series of Welch's t-tests with Bonferroni correction were conducted to explore whether there were potential differences in the variables of interest according to whether or not the schools participated in the subsequent waves (see Table 2).

Table 2. Welch's t-tests for equivalence of means to explore differences according to whether or not the schools participated in subsequent waves

Variable	Mean did not participate	Mean Participated	*t*	Adj. 95% CI	Adj. *p*
	Wave 1				
ITU	5.91	6.28	-2.83	-0.76-0.01	0.06
PU	11.29	11.7	-1.30	-1.34-0.51	1.00
PEOU	16.75	17.69	-2.33	-2.09-0.23	0.25
PS	17.13	18.15	-2.46	-2.22-0.18	0.18
Digital self-efficacy	21.75	22.12	-0.78	-1.75-1.01	1.00
Technology comfort	3.47	3.44	0.33	-0.26-0.33	1.00
Value	23.38	22.75	0.94	-1.31-2.58	1.00
Taking part	18.05	18.59	-0.69	-2.83-1.74	1.00
Home learning environment	11.99	12.14	-0.42	-1.14-0.85	1.00
Academic use intention	26.11	27.9	-1.77	-4.74-1.16	0.95
Non-academic use intention	15.22	15.55	-0.32	-3.32-2.65	1.00
Age	14.42	14.48	-0.31	-0.61-0.49	1.00
	Wave 2				
ITU	5.98	6.30	-2.03	-0.79-0.15	0.54
PU	11.29	11.90	-1.66	-1.69-0.47	1.00
PEOU	16.88	17.87	-1.95	-2.48-0.51	0.66
PS	17.41	17.96	-1.04	-2.11-1.01	1.00
Digital self-efficacy	21.84	22.11	-0.49	-1.90-1.36	1.00
Technology comfort	3.46	3.46	-0.06	-0.32-0.31	1.00
Value	23.16	23.02	0.20	-1.91-2.18	100
Taking part	18.09	18.76	-0.79	-3.16-1.82	1.00
Home learning environment	12.18	11.74	1.15	-0.67-1.54	1.00
Academic use intention	26.27	28.43	-2.13	-5.10-0.80	0.42
Non-academic use intention	14.94	16.52	-1.51	-4.66-1.50	1.00
Age	14.41	14.56	-0.89	-0.68-0.36	1.00
	Wave 3				
ITU	6.11	5.98	0.78	-0.34-0.59	1.00
PU	11.59	11.21	1.02	-0.72-1.49	1.00
PEOU	17.2	17.06	0.31	-1.18-1.46	1.00
PS	17.77	17.16	1.24	-0.84-2.07	1.00
Digital self-efficacy	22.31	21.11	2.44	-0.24-2.64	0.19
Technology comfort	3.52	3.34	1.64	-0.14-0.49	1.00
Value	23.23	22.9	0.48	-1.68-2.33	1.00
Taking part	18.54	17.75	0.98	-1.55-3.12	1.00
Home learning environment	12.06	12.03	0.08	-1.01-1.07	1.00
Academic use intention	26.88	26.83	0.05	-2.99-3.08	1.00
Non-academic use intention	15.64	14.78	0.81	-2.24-3.96	1.00
Age	14.57	14.2	1.98	-0.17-0.90	0.60

Note: ITU = intention to use; PU = perceived usefulness; PEOU = perceived ease of use; PS = perceived satisfaction. Confidence intervals and p-values adjusted using the Bonferroni correction.

As can be seen from Table 2 there were no significant differences for the variables of interest at baseline according to which waves the schools participated in. Therefore, it seems that the attrition was not systematic.

Measures

An online survey was developed and administered to learners four times during the evaluation. All the measures were agreed with colleagues at the Digital Poverty Alliance prior to each wave of data collection. The survey included a range of existing measures and measures generated for the current evaluation. There was some variation in which measures were included in the online survey according to time point (see Table 3).

Table 3. Surveys contained in each wave in data collection

Measure	Baseline	Wave 1	Wave 2	Wave 3
Age	+	+	+	+
Gender	+	+	+	+
Language spoken at home	+			
School	+	+	+	+
Year group	+			
Device type	+			
Home learning environment	+	+	+	+
Duration of use		+	+	+
Social support and importance			+	+
Peer usefulness			+	+
Intended device use				
Academic use at home	+			
Non-academic use at home	+			
Actual device use				
Academic use at school		+	+	+
Academic use at home		+	+	+
Non-academic use at home		+	+	+
Engagement with School				
Value	+	+	+	+
Taking part	+	+	+	+
Technology acceptance				
Perceived satisfaction	+	+	+	+
Perceived usefulness	+	+	+	+
Perceived ease of use	+	+	+	+
Intention to use	+	+	+	+
Digital self-efficacy	+	+	+	+
Technology comfort	+	+	+	+

Note + denotes when a measure was used.

Baseline Measures

Personal information collected at baseline included age, gender, the language primarily spoken at home, school attended, year group, and the type of device provided by the Tech4Schools scheme.

Home learning environment. Four items were co-developed with the Digital Poverty Alliance to gather information about the learners' home environment and the resources available to them to complete schoolwork at home: '*I have suitable space to do my homework'*, *'I have a desk that I can use to do my homework'*, *'I have a quiet space to do my homework',* and *'I have a fast enough internet connection to do my homework'*. Participants responded using a 4-point Likert scale to indicate their agreement ranging from '*Strongly disagree*' to '*Strongly agree*'. Items were summed with higher scores indicating a more positive home learning environment.

School engagement. The value and taking part sub-scales from the secondary learner survey (Underwood et al., 2010) were included to assess engagement with school. The six-item value subscale measured the importance students place on education (e.g., '*It is important to me to do well in school'* and *'I work hard because I enjoy it'*). The six-item taking part subscale assessed students' perceptions of the extent to which they participate in activities at school (e.g., '*I do not think that what I learn at school will help me with my future dreams'* and '*I've pretty much given up being involved in things at school*'). Participants responded to the items using a 5-point Likert scale ranging from '*Strongly disagree*' to '*Strongly agree*'. Where necessary, items were reverse coded and then summed such that higher scores indicated higher levels of value and taking part in school.

Technology comfort. A single-item measure was used to assess comfort with computer technology: '*How comfortable are you with using computer technology?'.* Responses ranged from '*Not at all comfortable*' to '*Very comfortable*' on a 4-point Likert scale.

Intended device use. Intended device use was assessed using a modified version of the laptop use scale (Kay & Laurciella, 2016). Specifically, the components assessing academic use outside of school, and non-academic use outside of school were adapted in several ways. As the original items were developed for university students, to reflect the age of the current sample, the wording of the items was simplified (e.g., '*Searching the web for academic purposes'* was adapted to '*Searching the web to find something for schoolwork')* or items were removed (e.g., *Searching the university library databases for articles/books'*). To reflect that the Tech4Schools device could be a laptop or tablet, the wording of the scales was adapted to include reference to 'the device' rather than a laptop specifically. The wording was also modified to measure intention rather than actual use (e.g., '*How often do you think you will use the device outside of school for the following activities?*). This was because at baseline the students had either not yet received the devices or had only just received them. This resulted in two sub-scales: Academic use at home (8 items, e.g., "*Online interactive activities (for example learning objects, Applets)"*) and non-academic use at home (6 items, e.g., "*Playing games"*). Responses were recorded on a 5-point Likert scale ranging from '*Never*' to '*Very Frequently*'. Items were summed such that high scores indicated greater use.

Technology acceptance scale. Attitudes towards the device were assessed using a measure of the Technology Acceptance Model (TAM) based on the version for e-learning developed by Al-Azawei et al. (2017). The scale consisted of four subscales: intention to use the device (ITU, 1 item, e.g., '*When I have access to the device, I intend to use it*'), perceived usefulness (PU, 2 items, e.g., *'Using the device will improve my performance'*), perceived ease of use (PEOU, 3 items e.g., *'I will find the device easy to use'*) and perceived satisfaction (PS, 3 items e.g., '*Overall, I will be satisfied with the device'*). At baseline, the items were worded to gather expectations for the device, as students had not yet used the devices. Responses

were recorded on a 7-point Likert scale ranging from '*Strongly disagree*' to '*Strongly agree*'. Items were summed such that high scores indicated higher agreement.

Digital self-efficacy. Learners' self-efficacy for using digital devices was measured using the 7-item Digital Media Self-Efficacy Scale (e.g., *'I'm good with digital devices'* and *'I feel good using my digital devices at home';* Hammer et al., 2021). Reponses were recorded on a 4-point Likert scale ranging from '*Strongly disagree*' to '*Strongly agree*'. One item was reverse coded, and items were summed such that high scores indicated higher technology self-efficacy.

Wave 1 measures

Several changes to the online survey were made at Wave 1. Questions reflecting to primary language spoken at home, year group, and device type were removed to reduce the length and burden of the survey. Additionally, the wording of several scales was changed to reflect that the students had received and used the devices. Specifically, the device use and technology acceptance (e.g., *'Now that I have access to the device, I intend to use it'* and *'Using the device has improved my performance'*) scales made reference to device use and the impact of the device on learning over the previous six weeks. Two additional measures were also included.

Actual device use. A modified version of the academic use in school component of the laptop use scale (Kay & Laurciella, 2016) was included at Wave 1. As with the components at Baseline, the wording was altered to refer to the Tech4School device, and items simplified to suit school students. This resulted in 8 items (e.g., *'Using the notes posted by the teacher'* and *'Following a PowerPoint presentation on your device'*), with responses recorded on a 5-point Likert scale ranging from '*Never*' to '*Frequently*'. Items were summed to indicate greater frequency of academic use in school.

Duration of use. We included a measure of the amount of time spent using the device at school and at home. Home use was measured separately for weekdays (e.g., *'Thinking about an average weekday (Monday to Friday) over the last six weeks, how many hours per day did you use your device: At school?*) and weekend days (e.g., *'Thinking about an average weekend day (Saturday and Sunday) over the last six weeks, how many hours per day did you use your device: At home?'*). The response scale followed the guidance given by Marciano and Camerini (2022), who found that a 9-point scale was comparable to objective digital trace data for smartphone use in adolescents. The scale points were '*Never*', '*Up to 0.5 hours, 'between 0.5 and 1 hour*', '*Between 1 and 1.5 hours*', '*Between 1.5 and 2 hours*', '*Between 2 and 3 hours*', '*Between 3 and 4 hours*', '*Between 4 and 5 hours*', and '*5 or more hours*'. Higher scores indicated greater self-reported device use.

Wave 2 and Wave 3 measures

The surveys for waves 2 and 3 were identical and included three additional measures to those found in Wave 1.

Social support. Perceived social support for use of the device was measured for family, teachers, and classmates using single item measures co-developed with the Digital Poverty Alliance. For example, family support was measured with the item *'My family support my use of the device'*. Responses were gathered on a 5-point Likert scale ranging from '*Strongly disagree*' to '*Strongly agree*' with higher scores indicating greater levels of social support.

Perceived importance of social support. The perceived importance of social support received from family, teachers, and classmates was also measured using single item measures co-developed with the Digital Poverty Alliance. For example, the importance of family support was measured with the item *'What my family thinks of my learning is important to me'*. Reponses were gathered on a 5-point Likert scale ranging from '*Strongly disagree*' to

'*Strongly agree*'. Higher scores indicated greater perceived importance of the social support received.

Perceived usefulness of the device for peers. The degree to which students thought that the device would be useful for their peers was assessed using a single item: *'Using the device would be useful for my classmates'*. Reponses were gathered on a 5-point Likert scale ranging from '*Strongly disagree*' to '*Strongly agree*'. Higher scores indicated greater perceived usefulness for peers.

Procedure

The online surveys were created and hosted on Qualtrics software (Qualtrics, Provo, UT). Favourable ethical approval for this study was obtained from the Schools of Business, Law, and Social Sciences Research Ethics Committee at Nottingham Trent University. Information about the evaluation was sent by colleagues at the Digital Poverty Alliance to the schools participating in the Tech4Schools scheme. Schools were provided with an information sheet that outlined the nature of the evaluation and were asked to return a signed head teacher consent form to the NTU team, if they were happy to participate. Schools also shared information sheets with parents/guardians of eligible students. Parents/guardians were given the opportunity to opt their child(ren) out of the study. Once consent forms were returned, survey links were distributed to schools via email, and school contacts were responsible for sharing the surveys with the students. Learners that were opted out of the evaluation did not receive the survey link and were given alternative activities as determined by their teachers. Participating learners received information about the study at the beginning of the online survey, and gave their consent at this point. At all stages it was made clear to headteachers, parents/guardians, and learners that participation in the evaluation was voluntary and that non-participation would not impact their access to the Tech4Schools scheme.

Missing data approach

As noted in the sections on the sample characteristics and attrition, there was variation in the number of respondents according to timepoint. For the purposes of the evaluation missing data was not replaced to ensure we were working with the exact data. Although multiple imputation could have been used, there is some evidence that using multiple imputation can produce bias estimates of regression coefficients (Allison, 2000) and the majority of the missing data was in waves 1, 2, and 3 where variables were typically treated as outcome variables. Further, the mixed effect models used restricted maximum likelihood estimation that accounted for missing data (Kenward & Roger, 1997).

Survey with Learners Results

Scale properties

The properties of the scales were examined using exploratory factor analyses using the *psych* package in R (Revelle, 2022) and confirmatory factor analyses using the Lavaan package (Rosseel, 2012) as appropriate. For the exploratory factor analyses item loadings above 0.3 (Child, 1990) and a Tucker-Lewis Index (TLI) close to 0.95 (Hu & Bentler, 1999) were considered to indicate a good fit. For the confirmatory factor analysis acceptable fit is denoted by a Comparative Fit Index (CFI) above 0.90 (Hu & Buttler, 1999) although Blunch (2008) advocates for a CFI above 0.80, an RMSEA less than 0.080 (MacCallum et al., 1996), SRMR less than 0.80 (Hu & Buttler, 1999), and item loadings above .60 (Netemeyer et al., 2003). When interpreting the confirmatory factor analyses it is important to acknowledge that a large sample size is advocated for this type of analysis (Byrne, 2010). The internal consistency of the scales was also examined at each timepoint.

Home learning environment

As the home learning environment scale was developed for the current evaluation, exploratory factor analysis was carried out to explore the factor structure of the scale at baseline. Parallel analysis was conducted and suggested a single factor structure. Principle axis factor analysis with ordinary least squares suggested a good fit of a single factor structure, with all loadings above 0.3 and TLI=1.026. The Cronbach's alpha for the home learning environment scale was 0.78 suggesting acceptable reliability (Kline, 1993). Confirmatory factor analyses revealed that the scale had an appropriate factor structure for waves 1, 2, and 3 (see Table 4). Although it should be noted that the RMSEA at wave 1 is indicative of not a complete fit.

Table 4. Confirmatory factor analysis of home learning environment scale

	Wave 1			Wave 2			Wave 3		
Item	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*
HLE1	0.72	0.95	0.00	0.70	0.97	0.00	0.55	0.89	0.00
HLE2	0.67	0.72	0.00	0.65	0.75	0.00	0.44	0.61	0.00
HLE3	0.43	0.58	0.00	0.59	0.78	0.00	0.55	0.81	0.00
HLE4	0.42	0.55	0.00	0.42	0.55	0.00	0.43	0.64	0.00
Fit Measures									
CFI	0.964			1.000			1.000		
RMSEA	0.154			0.000			0.000		
SRMR	0.052			0.008			0.027		

Home academic and non-academic intended device use

Due to the modifications made to the laptop use scale to assess intended device use for academic purposes at home and non-academic purposes, exploratory factor analysis was carried out separately for both scales at baseline. Parallel analysis suggested a two-factor structure for academic use at home. However, the Scree plot and factor loadings suggested a single factor structure was more suitable. Principle axis factor analysis with ordinary least

squares suggested an acceptable fit (loadings above 0.3; TLI = 0.76). Confirmatory factor analyses revealed that the academic use school at home for wave 1 and wave 2 had an appropriate structure as single factor. However, the fit statistics at wave 3 indicate a less good fit (see Table 5).

Table 5. Confirmatory factor analyses of academic use at home scale

	Wave 1			Wave 2			Wave 3		
Item	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*
AU1	0.90	0.75	0.00	0.94	0.83	0.00	1.01	0.75	0.00
AU2	0.65	0.64	0.00	0.48	0.47	0.00	0.49	0.52	0.00
AU3	0.86	0.65	0.00	0.60	0.54	0.00	0.86	0.59	0.00
AU4	0.84	0.71	0.00	0.71	0.62	0.00	0.73	0.65	0.00
AU5	1.07	0.80	0.00	1.06	0.86	0.00	1.24	0.84	0.00
AU6	1.25	0.88	0.00	1.16	0.87	0.00	0.92	0.74	0.00
AU7	1.13	0.83	0.00	1.14	0.87	0.00	1.01	0.78	0.00
AU8	1.00	0.71	0.00	1.17	0.88	0.00	1.15	0.77	0.00
Fit Measures									
CFI	0.831			0.902			0.650		
RMSEA	0.209			0.163			0.307		
SRMR	0.071			0.095			0.126		

The parallel analysis suggested a single factor structure for non-academic use at home. Principle axis factor analysis with ordinary least squares suggested a good fit of non-academic use at home (loadings >0.3, TLI = 0.927). The confirmatory factor analysis for the non-academic use at home scale indicated that the scale had an appropriate factor structure for each of the waves 1, 2, and 3 (see Table 6).

Table 6. Confirmatory factor analyses of non-academic use at home scale

	Wave 1			Wave 2			Wave 3		
Item	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*
NAU1	1.11	0.80	0.00	1.04	0.75	0.00	1.11	0.80	0.00
NAU2	1.02	0.76	0.00	1.12	0.82	0.00	1.02	0.76	0.00
NAU3	1.20	0.93	0.00	1.13	0.78	0.00	1.20	0.93	0.00
NAU4	1.15	0.87	0.00	1.14	0.86	0.00	1.15	0.87	0.00
NAU5	1.04	0.78	0.00	1.03	0.75	0.00	1.04	0.78	0.00
NAU6	0.90	0.67	0.00	0.79	0.60	0.00	0.90	0.67	0.00
Fit Measures									
CFI	0.956			0.967			0.956		
RMSEA	0.141			0.108			0.141		
SRMR	0.049			0.051			0.049		

Academic use at school

The confirmatory factor analyses of the academic use at school scale was an appropriate fit at wave 1 and wave 2 (see Table 7). However, the RMSEA and SRMR suggest that the model is not a complete fit at wave 3.

Table 7. Confirmatory factor analysis of academic use at school scale

	Wave 1			Wave 2			Wave 3		
Item	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*
AUS1	1.12	0.81	0.00	1.29	0.85	0.00	1.00	0.71	0.00
AUS2	1.23	0.85	0.00	1.43	0.90	0.00	1.41	0.92	0.00
AUS3	1.31	0.92	0.00	1.50	0.93	0.00	1.42	0.96	0.00
AUS4	1.16	0.79	0.00	1.38	0.91	0.00	1.07	0.70	0.00
AUS5	0.84	0.65	0.00	1.24	0.83	0.00	1.09	0.74	0.00
AUS6	1.30	0.88	0.00	1.42	0.92	0.00	1.48	0.96	0.00
AUS7	1.14	0.76	0.00	1.02	0.73	0.00	1.26	0.81	0.00
AUS8	1.31	0.89	0.00	1.50	0.96	0.00	1.43	0.95	0.00
Fit Measures									
CFI	0.945			0.942			0.867		
RMSEA	0.136			0.168			0.257		
SRMR	0.045			0.032			0.083		

Technology Acceptance Model scale

A three-factor structure for the TAM scale with separate factors for perceived usefulness, perceived ease of use, and perceived satisfaction was tested. Across all waves, the RMSEA exceeded the recommended value, although all other values were indicative of a good fit (see Table 8).

Table 8. Confirmatory factor analysis of the TAM scale

	Baseline			Wave 1			Wave 2			Wave 3		
Item	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*
PU1	0.94	0.86	0.00	1.09	0.89	0.00	1.02	0.92	0.00	0.88	0.91	0.00
PU2	1.13	0.97	0.00	1.15	0.96	0.00	1.11	0.98	0.00	1.06	0.95	0.00
PEOU1	0.83	0.77	0.00	0.96	0.82	0.00	0.80	0.87	0.00	0.75	0.83	0.00
PEOU2	0.81	0.61	0.00	1.02	0.69	0.00	0.60	0.47	0.00	0.84	0.73	0.00
PEOU3	0.69	0.71	0.00	0.92	0.87	0.00	0.79	0.89	0.00	0.79	0.91	0.00
PS1	1.00	0.88	0.00	1.06	0.94	0.00	0.78	0.87	0.00	0.84	0.89	0.00
PS2	0.94	0.91	0.00	1.06	0.95	0.00	0.78	0.89	0.00	0.95	0.94	0.00
PS3	0.81	0.82	0.00	1.05	0.95	0.00	0.80	0.94	0.00	0.86	0.95	0.00
Fit Measures												
CFI	0.952			0.973			0.961			0.901		
RMSEA	0.123			0.117			0.126			0.229		
SRMR	0.045			0.027			0.044			0.046		

Digital self-efficacy scale

The confirmatory factor analyses of digital self-efficacy scale revealed that the scale was a limited fit of the data at each timepoint (see Table 9). The loadings for item 7 were lower than the other items (it should be noted that item 7 was negatively worded and reverse coded).

Table 9. Confirmatory factor analysis of digital self-efficacy scale

	Baseline			Wave 1			Wave 2			Wave 3		
Item	B	*β*	p	B	*β*	p	B	*β*	p	B	*β*	p
SE1	0.30	0.56	0.00	0.42	0.79	0.00	0.28	0.56	0.00	0.67	0.69	0.00
SE2	0.37	0.60	0.00	0.53	0.82	0.00	0.46	0.77	0.00	0.83	0.78	0.00
SE3	0.49	0.66	0.00	0.59	0.78	0.00	0.57	0.72	0.00	1.19	0.83	0.00
SE4	0.23	0.45	0.00	0.41	0.68	0.00	0.30	0.54	0.00	0.62	0.66	0.00
SE5	0.61	0.81	0.00	0.44	0.68	0.00	0.66	0.93	0.00	1.15	0.87	0.00
SE6	0.61	0.81	0.00	0.65	0.83	0.00	0.70	0.89	0.00	1.23	0.88	0.00
SE7	0.14	0.15	0.06	-0.24	-0.24	0.03	-0.11	-0.13	0.33	-1.16	-0.73	0.00
Fit Measures												
CFI	0.772			0.757			0.890			0.864		
RMSEA	0.197			0.266			0.168			0.218		
SRMR	0.100			0.091			0.080			0.070		

Value

The confirmatory factor analyses of the value scale revealed that the scale had a good fit at baseline but that this reduced over time (see Table 10).

Table 10. Confirmatory factor analysis of value scale

	Baseline			Wave 1			Wave 2			Wave 3		
Item	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*	B	*β*	*p*
V1	0.35	0.50	0.00	0.47	0.63	0.00	0.55	0.60	0.00	0.41	0.54	0.00
V2	0.53	0.52	0.00	0.48	0.50	0.00	0.41	0.43	0.00	0.51	0.48	0.00
V3	0.79	0.67	0.00	0.85	0.85	0.00	0.79	0.73	0.00	0.84	0.76	0.00
V4	0.66	0.60	0.00	0.76	0.80	0.00	0.49	0.56	0.00	0.62	0.58	0.00
V5	0.89	0.75	0.00	0.73	0.76	0.00	0.73	0.68	0.00	0.86	0.82	0.00
V6	0.88	0.76	0.00	0.72	0.73	0.00	0.72	0.72	0.00	0.81	0.75	0.00
Fit Measures												
CFI	0.964			0.861			0.769			0.78		
RMSEA	0.080			0.211			0.214			0.236		
SRMR	0.044			0.082			0.102			0.103		

Taking part

The confirmatory factor analyses of the taking part scale revealed that the scale had a good fit at baseline (except the RMSEA) but there was variation over time with a good fit at wave 2 and less good fits at wave 1 and 3 (see Table 11).

Table 11. Confirmatory factor analysis of taking part scale

	Baseline			Wave 1			Wave 2			Wave 3		
Item	B	*β*	p	B	*β*	p	B	*β*	p	B	*β*	p
TP1	0.62	0.46	0.00	0.66	0.52	0.00	0.73	0.63	0.00	0.88	0.71	0.00
TP2	0.71	0.57	0.00	0.90	0.70	0.00	0.48	0.45	0.00	0.87	0.75	0.00
TP3	1.00	0.73	0.00	0.85	0.69	0.00	0.80	0.67	0.00	0.86	0.71	0.00
TP4	1.05	0.79	0.00	0.82	0.68	0.00	1.01	0.82	0.00	0.80	0.72	0.00
TP5	0.78	0.63	0.00	0.92	0.83	0.00	0.61	0.55	0.00	0.92	0.77	0.00
TP6	0.60	0.54	0.00	0.91	0.79	0.00	0.68	0.62	0.00	0.72	0.59	0.00
Fit Measures												
CFI	0.900			0.834			0.989			0.864		
RMSEA	0.134			0.225			0.042			0.196		
SRMR	0.059			0.075			0.052			0.076		

Internal consistencies

The Cronbach's alpha was calculated for each of the scales administered at each timepoint as a measure of internal consistency. All of the scales had at least acceptable (>0.7) internal consistency (Kline, 1993; see Table 12

Table 12. The Cronbach's alpha values and n for each scale across timepoints

		Baseline		Wave 1		Wave 2		Wave 3	
Scale/item	Number of items	*N*	α	*N*	α	*N*	α	*N*	A
ITU	1	192	-	107	-	67	-	78	-
PU	2	185	0.87	102	0.93	64	0.87	78	0.87
PEOU	3	186	0.75	103	0.80	64	0.75	79	0.75
PS	3	187	0.89	107	0.96	62	0.89	73	0.89
Digital self-efficacy	7	170	0.76	88	0.73	65	0.76	83	0.76
Technology comfort	1	186	-	110	-	71	-	79	-
Value	6	183	0.80	108	0.85	66	0.80	78	0.80
Taking part	6	182	0.78	99	0.83	61	0.78	72	0.78
Academic use intention at home	8	171	0.86	-	-	-	-	-	-
Non-Academic use intention at home	6	181	0.89	-	-	-	-	-	-
School use	1	-	-	105	-	60	-	80	-
Weekday home use	1	-	-	98	-	59	-	75	-
Weekend home use	1	-	-	108	-	67	-	80	-
Academic use at school	8	-	-	99	0.94	59	0.97	75	0.96
Academic use at home	8	-	-	94	0.91	64	0.91	75	0.89
Non-academic use at home	6	-	-	92	0.91	66	0.88	73	0.90
Home learning environment	4	191	0.78	99	0.78	64	0.78	75	0.78

Note: ITU = Intent to Use; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction

Descriptive statistics across waves

Table 13 contains the means and standard deviations for the variables across wave.

Table 13. The descriptive statistics for the variables across waves with means, (standard deviations), and range

Variable	Baseline		Wave 1		Wave 2		Wave 3	
	Mean (standard deviation)	Range	Mean (standard deviation)	Range	Mean (standard deviation)	Range	Mean (standard deviation)	Range
Age	14.45 (1.39)	12-17	14.31 (1.35)	11-17	14.44 (1.12)	12-16	14.24 (1.29)	11-16
Weekday use at school	–	–	3.66 (2.67)	1-9	2.52 (2.27)	1-9	4.12 (2.74)	1-9
Weekday use at home	–	–	6.16 (1.85)	1-9	6.14 (2.15)	1-9	5.60 (1.92)	1-9
Weekend use at home	–	–	6.64 (2.14)	1-9	6.25 (2.20)	1-9	6.28 (1.87)	2-9
Academic use intention at home	26.87 (6.80)	8-40	–	–	–	–	–	–
Non-academic use intention at home	15.36 (6.74)	6-30	–	–	–	–	–	–
Academic use at school	–	–	24.02 (9.75)	8-40	20.98 (11.06)	8-40	26.07 (10.61)	8-40
Academic use at home	–	–	26.77 (8.1)	8-40	24.89 (7.69)	8-40	27.85 (7.89)	8-40
Non-academic use at home	–	–	14.3 (6.73)	6-30	15.33 (6.66)	5-25	13.15 (6.45)	6-29
Family support	–	–	–	–	4.47 (0.76)	2-5	4.08 (1.03)	1-5
Teacher support	–	–	–	–	4.03 (1.11)	1-5	4.06 (0.96)	1-5
Classmate support	–	–	–	–	4.02 (1.11)	1-5	3.63 (1.42)	1-5
Family importance	–	–	–	–	4.37 (0.84)	2-5	4.09 (0.99)	1-5
Teacher importance	–	–	–	–	4.17 (0.94)	2-5	4.06 (0.95)	1-5
Classmate importance	–	–	–	–	3.41 (1.08)	1-5	3.17 (1.30)	1-5

Variable	Baseline		Wave 1		Wave 2		Wave 3	
	Mean (standard deviation)	Range	Mean (standard deviation)	Range	Mean (standard deviation)	Range	Mean (standard deviation)	Range
Peer usefulness	–	–	–	–	3.82 (0.97)	1-5	3.85 (1)	1-5
Value	23.12 (4.56)	6-30	22.54 (4.35)	6-30	22.76 (4.18)	6-30	23.28 (4.52)	6-30
Taking part	18.27 (5.35)	6-30	20.31 (5.52)	6-30	19.34 (4.87)	6-30	20.57 (5.48)	7-30
PU	11.46 (2.17)	2-14	11.5 (2.32)	2-14	11.22 (2.21)	4-14	11.83 (2.1)	7-14
PEOU	17.16 (2.81)	3-21	17.51 (3.21)	3-21	17.62 (2.66)	12-21	18.34 (2.75)	12-21
PS	17.57 (2.9)	3-21	18.07 (3.23)	3-21	18.32 (2.48)	12-21	18.67 (2.74)	12-21
ITU	6.07 (0.95)	2-7	6.15 (1.05)	1-7	5.85 (1.16)	1-7	6.09 (1.06)	1-7
Digital self-efficacy	21.91 (3.12)	7-28	21.75 (3.16)	12-28	21.43 (3.24)	13-28	23.59 (5.02)	15-35
Technology comfort	3.46 (0.69)	1-4	3.40 (0.73)	1-4	3.48 (0.58)	2-4	3.37 (0.62)	2-4
Home learning environment	12.05 (2.48)	4-16	12.41 (2.52)	4-16	12.42 (2.57)	4-16	12.79 (2.18)	4-16

Note: ITU = Intention to Use; PU = Perceived Usefulness; PEOU = Perceived Ease of Use; PS = Perceived Satisfaction.

As outlined in Table 13, there was evidence of a range of responses across the study variables with the mean values tending to fall towards the centre of the range at each timepoint. The exception to this was for the family support and teacher support variables at wave 2 and wave 3 with a mean that tended to be closer to the upper limit of the range.

Exploring differences between learners at baseline

Primary language spoken at home

To investigate differences according to the language learners primarily spoke at home, learners were grouped according to whether they reported primarily speaking English at home (n = 135) or primarily speaking a different language (n = 68). Learners' scores according to the language primarily spoken at home were compared using Welch's t-test for intention to use, perceived usefulness, perceived ease of use, perceived satisfaction, digital self-efficacy, technology comfort, value, taking part, academic use intention at home, and non-academic use intention at home. Due to the number of tests performed Bonferroni's correction was used to adjust the *p* values.

As reported in Table 14, the results indicated that learners who primarily spoke a language other than English at home scored significantly higher on technology comfort and the value scale compared to those learners who primarily spoke English. There were no other significant differences.

Table14. Welch's t-tests for equivalence of means to explore differences according to primary language spoken at home at baseline

Comparison	English Mean	Other Mean	*t*	Adj. 95% CI	Adj. *p*
ITU	6.02	6.17	-0.97	-0.58 - 0.29	1.00
PU	11.29	11.85	-1.59	-1.6 - 0.46	1.00
PEOU	16.92	17.68	-1.61	-2.11 - 0.59	1.00
PS	17.33	18.08	-1.57	-2.12 - 0.62	1.00
Digital self-efficacy	21.64	22.51	-1.64	-2.4 - 0.65	1.00
Technology comfort	3.37	3.66	-2.99	-0.57 - -0.01	**0.03**
Value	22.51	24.31	-2.87	-3.57 - -0.01	**0.05**
Taking part	17.72	19.66	-2.37	-4.27 - 0.4	0.19
Home academic use intention	26.11	27.91	-1.68	-4.87 - 1.26	0.95
Home non-academic use intention	14.96	16.06	-1.14	-4.23 - 1.82	1.00

Note: p-values and 95% confidence intervals adjusted using Bonferroni correction. ITU = Intention to Use; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction.

Gender

Potential gender differences between male (n=106) and female (n=96) learners at baseline for the study variables were investigated using Welch's t-tests. Non-binary/third gender learners were not included due to low sample size (n=4). Learners' scores according to gender male/female were compared on intention to use, perceived usefulness, perceived ease of use, perceived satisfaction, digital self-efficacy, technology comfort, value, taking part, academic use intention at home, and non-academic use intention at home. Due to the number of tests performed Bonferroni's correction was used to adjust the *p* values. As reported in Table 15, there were no significant differences between male and female learners on these scales.

Table 15. Welch's t-tests for equivalence of means to explore differences according to gender as baseline

Comparison	Female Mean	Male Mean	*t*	Adj. 95% CI	Adj. *p*
ITU	6.11	6.06	0.36	-0.33 - 0.42	1.00
PU	11.49	11.48	0.03	-0.88 - 0.91	1.00
PEOU	16.97	17.42	-1.08	-1.61 - 0.71	1.00
PS	17.51	17.67	-0.36	-1.36 - 1.05	1.00
Digital self-efficacy	21.46	22.3	-1.74	-2.17 - 0.50	0.84
Technology comfort	3.45	3.46	-0.09	-0.30 - 0.28	1.00
Value	22.99	23.34	-0.53	-2.20 - 1.49	1.00
Taking Part	18.75	17.87	1.11	-1.32 - 3.08	1.00
Home academic use intention	27.09	26.89	0.18	-2.78 - 3.17	1.00
Home non-academic use intention	15.14	15.55	-0.40	-3.33 - 2.51	1.00

Note: p-values and 95% confidence intervals adjusted using Bonferroni correction. ITU = Intention to Use; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction.

Age

To explore whether the learners' age was associated with variables of interest at baseline, Pearson's correlations were used. Specifically, the associations between learners' age, intention to use, perceived usefulness, perceived ease of use, perceived satisfaction, self-efficacy, technology comfort, value, and taking part (see Table 16).

Table 16. Baseline Pearson correlations with age

Variable	Correlation
ITU	0.014
PU	0.161*
PEOU	0.053
PS	0.025
Digital self-efficacy	0.146
Technology comfort	0.155*
Value	0.138
Taking part	-0.012
Home academic use intention	0.186*
Home non-academic use intention	-0.013
Home learning environment	0.231**

*Note: * p<.05 ** p<.01 *** p<.001 Note: ITU = Intention to Use; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction*

Age was positively associated with perceived usefulness, technology comfort, academic use intention, and home learning environment. Being older age was associated with higher perceived usefulness, higher technology comfort, higher home academic use intention, and a more positive learning environment.

Correlations among variables at each timepoint

A series of Pearson's correlations were used to explore the relationships between the measures across the various timepoints. Cohen's (1998) guidelines were used to determine the strength of associations: between 0.10 and 0.29 are small, 0.30 and 0.49 medium, and 0.50 and 1.0 large.

Baseline

At baseline there were several significant associations between measures (see Table 17).

Table 17. Pearson's correlations between measures at baseline

	1	2	3	4	5	6	7	8	9	10
1. ITU	-									
2. PU	0.552***	-								
3. PEOU	0.467***	0.576***	-							
4. PS	0.559***	0.624***	0.698***	-						
5. Digital self-efficacy	0.272***	0.266***	0.388***	0.302***	-					
6. Technology comfort	0.131	0.102	0.254***	0.103	0.460***	-				
7. Value	0.234**	0.329***	0.308***	0.338***	0.225**	0.097	-			
8. Taking part	0.101	0.111	0.166*	0.212**	0.170*	0.162*	0.090	-		
9. Home academic use intention	0.299***	0.408***	0.346***	0.338***	0.319***	0.08	0.384***	0.071	-	
10. Home non-academic use intention	0.150*	0.088	0.092	0.077	0.032	0.092	-0.056	-0.117	0.122	-
11. Home learning environment	0.006	0.037	0.134	0.077	0.256**	0.223**	0.203**	0.100	0.187*	-0.008

** p<.05 ** p<.01 *** p<.001 Note: ITU = Intention to Use; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction*

As would be expected there were positive associations between those variables that comprised the TAM (intent to use, perceived usefulness, perceived ease of use, and perceived satisfaction) and the strength of these associations ranged from medium to large (Cohen, 1998). Relatedly, digital self-efficacy was also positively associated with all the variables that comprised the TAM and the strength of these associations ranged from small to medium. For example, higher scores on perceived satisfaction were associated with higher scores on perceived ease of use, perceived usefulness, and intent to use.

Digital self-efficacy was positively associated with technology comfort, academic use intention, and home learning environment. Reporting higher levels of digital self-efficacy was associated with higher levels of technology comfort, greater academic use intention, and a more positive home learning environment. The strength of these associations ranged from small to medium. Focusing on the school engagement measures, value had small to medium positive associations with all the variables within the TAM, digital self-efficacy, home academic use intention, and the home learning environment. Again, higher scores on value were associated with higher scores on the variables with the TAM, higher digital self-efficacy, higher home academic use intention, and a more positive home learning environment. Taking part had small to medium positive associations with only some of the variables from the TAM: perceived ease of use and perceived satisfaction, and digital self-efficacy, technology comfort and the home learning environment. Higher scores on taking part were associated with higher perceived ease of use, higher perceived satisfaction, higher digital self-efficacy, higher technology comfort, and a more positive learning environment.

Wave 1

Similar to baseline there were several significant associations between measures at Time 1 (see Table 18).

Table 18. Pearson's correlations between measures at Wave 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. School use	-													
2. Weekday home use	0.146	–												
3. Weekend home use	0.160	0.750***	–											
4. Academic use at school	0.481***	0.106	0.094	–										
5. Academic use at home	0.249*	0.346**	0.348***	0.566***	–									
6. Non-academic use at home	-0.113	0.362***	0.403***	-0.160	0.123	–								
7. ITU	0.029	0.345***	0.314**	0.115	0.441***	-0.011	–							
8. PU	0.209*	0.266*	0.337***	0.324**	0.579***	0.013	0.707***	–						
9. PEOU	0.083	0.287**	0.209*	0.137	0.444***	-0.012	0.787***	0.733***	–					
10. PS	0.091	0.375***	0.288**	0.091	0.390***	0.093	0.732***	0.782***	0.825***	–				
11. Digital self-efficacy	-0.026	0.426***	0.225*	0.082	0.305**	0.143	0.423***	0.247*	0.463***	0.436***	–			
12. Technology comfort	0.134	0.380***	0.230*	0.224*	0.326**	0.110	0.378***	0.269**	0.375***	0.472***	0.621***	–		
13. Value	0.039	0.252*	0.210*	0.158	0.460***	-0.139	0.392***	0.308**	0.368***	0.327**	0.313**	0.313**	–	
14. Taking part	0.060	-0.124	-0.014	0.019	0.285**	-0.147	0.354***	0.389***	0.409***	0.337**	0.049	0.033	0.254*	–
15. Home learning environment	0.117	0.388***	0.267*	0.216*	0.208	-0.136	0.067	-0.034	-0.010	-0.050	0.165	0.176	0.427***	-0.047

** p<.05 ** p<.01 *** p<.001 Note: ITU = Intention to Use; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction*

Again, and as would be expected, there were positive associations between those variables that comprised the TAM (intent to use, perceived usefulness, perceived ease of use, and perceived satisfaction). Relatedly, digital self-efficacy was also positively associated with all the variables that comprised the TAM and the strength of these associations ranged from small to medium. For example, higher scores on perceived satisfaction were associated with higher scores on perceived ease of use, perceived usefulness, and intent to use. There were also associations between the variables within the TAM and the device use measures. For example, there were small to medium positive associations between weekday home use, weekend home use, and academic use at home and all of the variables within the TAM. Specifically, greater weekday home use, greater weekend home use, and higher levels of academic use at home were associated with greater intent to use, perceived usefulness, perceived ease of use, and perceived satisfaction. Similarly, school use and academic use at school were positively associated with perceived usefulness: greater time spending the device at school and higher levels of academic use were associated with greater perceived usefulness. There were no associations between the variables within the TAM and non-academic use at home.

Although the amount of time using the device at school was not associated with time spent using the device at home, time using the device at school was associated with academic use of the device at school and home such that spending more time using the device at school was associated with greater academic use and at school. The strength of these associations was small to medium. There was a large association between the amount of time spending using the device at home during weekdays and during the weekend such that great time spent using the device during weekdays was associated with greater device use during the weekend.

Digital self-efficacy was positively associated with technology comfort, the amount of time spent using the device at home during weekdays and the weekend, and academic use at home. Reporting higher levels of digital self-efficacy was associated with spending more time using the device at home during weekdays and the weekend, and higher levels of academic use at home. The strength of these associations ranged from small to medium. Focusing on the school engagement measures, value had small to medium positive associations with all the variables within the TAM, digital self-efficacy, the time spent using the device at home during weekdays and weekends, and academic use at home. Again, higher scores on value were associated with higher scores on the variables with the technology acceptance model, higher digital self-efficacy, spending more time using the device at home during weekdays and the weekend, and higher levels of academic use at home. Taking part had small to medium positive associations with only some of the variables from the technology acceptance model: perceived ease of use and perceived satisfaction, and digital self-efficacy, technology comfort and the home learning environment. Higher scores on taking part were associated with higher perceived ease of use, higher perceived satisfaction, higher digital self-efficacy, higher technology comfort, and a more positive learning environment. Taking part was also associated with reports of academic use at home with higher scores for taking part associated with higher scores for academic use at home.

Wave 2

Similar to baseline and wave 1 there were several significant associations between measures at Time 2 (see Table 19).

Table 19. Pearson's correlations between measures at wave 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. School use	–																				
2. Weekday home use	0.364**	–																			
3. Weekend home use	0.290*	0.777***	–																		
4. Academic use at school	0.328*	0.228	0.159	–																	
5. Academic use at home	0.23	0.085	0.205	0.552***	–																
6. Non-academic use at home	0.00	0.292*	0.279*	0.128	0.414***	–															
7. ITU	-0.019	-0.161	-0.093	0.103	0.226	-0.036	–														
8. PU	-0.023	0.098	0.042	0.132	0.236	-0.012	0.642***	–													
9.PEOU	-0.425***	-0.097	-0.074	0.036	0.179	0.015	0.577***	0.550***	–												
10. PS	-0.194	-0.235	-0.099	-0.014	0.121	-0.191	0.696***	0.634***	0.702***	–											
11. Digital self-efficacy	0.071	0.191	0.105	0.293*	-0.139	-0.092	0.039	-0.013	0.153	-0.124	–										
12. Technology comfort	0.122	0.341**	0.297*	0.058	0.111	0.137	0.263*	0.305*	0.382**	0.227	0.452***	–									
13. Value	0.01	-0.335*	-0.12	0.105	-0.014	-0.206	0.233	0.099	0.323*	0.290*	0.304*	0.109	–								
14. Taking part	-0.046	-0.194	-0.161	-0.048	0.131	0.085	0.216	0.155	0.106	0.180	0.085	0.228	0.107	–							
15. HLE	0.237	-0.264	-0.144	0.172	-0.028	-0.185	0.380**	0.023	0.227	0.284*	0.308*	0.101	0.562**	-0.037	–						
16. Family support	-0.077	-0.006	0.031	0.176	0.228	0.078	0.426***	0.263*	0.467***	0.378**	0.263*	0.344**	0.262*	0.214	0.162	–					
17. Teacher support	0.071	-0.081	0.041	0.337*	0.178	-0.044	0.388**	0.187	0.284*	0.248	0.062	-0.002	0.199	0.053	0.271*	0.457***	–				
18. Peer support	0.032	0.088	0.056	0.313*	0.114	0.110	0.045	0.038	0.121	0.004	0.155	-0.013	0.201	0.149	-0.021	0.427***	0.711***	–			
19. Family importance	0.226	-0.043	-0.127	0.480***	0.292*	-0.102	0.286*	0.432***	0.179	0.233	0.237	0.071	0.162	0.256	0.125	0.207	0.159	0.097	–		
20. Teacher importance	0.256	0.242	0.178	0.540***	0.223	-0.106	0.130	0.264*	0.009	0.090	0.299*	0.164	0.223	0.289*	0.097	0.239	0.165	0.202	0.530**	–	
21. Peer importance	0.097	-0.100	-0.129	0.340***	0.183	-0.109	0.095	0.102	0.085	0.026	0.156	-0.222	0.271*	-0.097	0.249	0.049	0.274*	0.284*	0.370**	0.482**	–
22. Usefulness for peers	-0.034	0.112	0.150	0.290*	0.141	0.141	0.145	0.077	0.004	-0.029	0.021	-0.273*	-0.035	-0.238	0.055	0.141	0.282*	0.102	0.212	0.231	0.345**

** p<.05 ** p<.01 *** p<.001. Note: The value of .000 reflects an association of 0.00004. ITU = Intention to Use; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction; HLE = Home learning environment*

Again, and as would be expected, there were positive associations between those variables that comprised the TAM (intent to use, perceived usefulness, perceived ease of use, and perceived satisfaction). However, unlike baseline and wave 1, digital self-efficacy was not associated with the variables that comprised the TAM. Compared to the earlier waves, there were also fewer associations between the variables within the TAM and the device use measures and the nature of the relationships appears to be different. For example, the amount of time spent using the device at school was negatively associated with perceived ease of use: greater time spent using the device at school was associated with lower perceived ease of use and the strength of the relationship was medium.

Unlike wave 1, the amount of time spent using the device at school was associated with time spent using the device at home during weekdays and the weekend with more time spent using the device at school associated with more time spent using the device at home during weekdays and the weekend. However, as with wave 1, there was a large positive association between the amount of time spending using the device at home during weekdays and during the weekend such that greater time spent using the device during weekdays was associated with greater device use during the weekend. Academic use of the device at home was positively associated with academic use at school and non-academic use at home, with greater academic use at home associated with greater academic use at school and non-academic use at home. There were small positive associations between non-academic use at home and weekday home use and weekend home use such that reporting spending more time using the device at home during weekdays and the weekend was associated with greater non-academic use at home.

Digital self-efficacy was positively associated with technology comfort, academic use at school, and the home learning environment. Reporting higher levels of digital self-efficacy was associated with higher levels of technology comfort, higher levels of academic use at

school, and a more positive home learning environment. The strength of these associations ranged from small to medium. Focusing on the school engagement measures, value had small to medium positive associations with perceived ease of use, perceived satisfaction, and digital self-efficacy. Again, higher scores on value were associated with higher scores on perceived ease of use, perceived satisfaction, and digital self-efficacy. There was a medium negative association between value and weekday use of the device at school such that the greater the weekday use of technology at school, the lower the value. Unlike at baseline and wave 1, taking part was not associated with any of the variables from the TAM. The only significant relationship was the positive large association between taking part and the home learning environment, with high scores for taking part associated with a more positive learning environment.

Wave 2 also included measures of family, teacher, and peer support and importance, and usefulness for peers. Family support was positively associated with teacher support and peer support with high scores of family support associated with high teacher and peer support, the strength of these relationships was medium. There was also a strong positive relationship between teacher support and peer support with high scores of teacher support associated with high scores of peer support.

There were small to medium positive associations between family support and all of the TAM variables, digital self-efficacy, technology comfort, and value such that higher scores of family support were associated with higher levels of intent to use, perceived usefulness, perceived ease of use, perceived satisfaction, digital self-efficacy, and value. Teacher support was positively associated with academic use at school, intent to use, perceived ease of use, and home learning environment. Having high levels of teacher support was associated with greater academic use at school, greater intent to use the device, higher levels of perceived ease of use, and a more positive home learning environment. The strength of these

associations were small to medium. There was also a medium positive association between peer support and academic use at school, higher levels of peer support were associated with higher levels of academic use at school.

The measures of importance of education for family, peers, and teachers were positively associated with each other and with academic use at school and usefulness for peers with small to medium associations between the variables. Higher scores of importance for education for family were associated with higher scores for peers and teachers, and higher scores of importance peers was associated with higher scores for teachers. Higher scores of importance for education for family, teachers, and peers were associated with higher scores for academic use at school and usefulness for peers. There were also small to medium positive associations between family support and intent to use and perceived usefulness with higher levels of family support associated with higher levels of intent to use and perceived usefulness. There was a similar small association between teacher importance and perceived usefulness, digital self-efficacy, and taking part with higher levels of teacher importance associated with higher levels of perceived usefulness, higher digital self-efficacy, and greater taking part. Peer importance was associated with value, with higher levels of peer importance associated with greater levels of taking part; the strength of the association was small.

Wave 3

Similar to baseline and waves 1 and 2 there were several significant associations between measures at Time 2 (see Table 20).

Table 20. Pearson's correlations between measures at wave 3

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. School use	–																				
2. Weekday home use	-0.051	–																			
3. Weekend home use	0.077	0.691***	–																		
4. Academic use at school	0.592***	-0.064	0.036	–																	
5. Academic use at home	0.391***	0.140	0.062	0.729***	–																
6. Non-academic use at home	-0.478***	0.302*	0.184	-0.122	0.09	–															
7. ITU	0.213	-0.016	0.052	0.157	0.07	-0.200	–														
8. PU	0.383***	-0.101	-0.045	0.390***	0.424***	-0.233	0.764***	–													
9. PEOU	0.217	-0.143	-0.035	0.188	0.172	-0.194	0.792***	0.739***	–												
10. PS	0.244*	-0.104	-0.059	0.305*	0.359**	-0.240	0.689***	0.784***	0.843***	–											
11. Digital self-efficacy	0.214	0.058	0.066	0.208	0.019	-0.283*	0.355**	0.401***	0.299**	0.311**	–										
12. Technology comfort	-0.051	0.415***	0.440***	0.089	0.274*	0.173	0.203	0.200	0.233*	0.115	0.006	–									
13. Value	0.134	0.044	-0.044	0.367**	0.298*	-0.032	0.303**	0.390***	0.272*	0.412***	0.007	0.400***	–-								
14. Taking part	0.357**	-0.142	-0.064	0.273*	0.169	-0.533***	0.382**	0.298*	0.378**	0.318**	0.200	0.151	0.397***	–							
15. HLE	0.084	-0.070	-0.209	0.132	0.023	-0.124	0.130	0.240	0.202	0.318*	0.113	0.185	0.477***	0.208	–						
16. Family support	0.073	0.024	0.098	0.251*	0.176	-0.049	0.215	0.231*	0.286*	0.246*	0.062	0.267*	0.126	0.156	0.184	–					
17. Teacher support	0.147	-0.122	-0.068	0.147	0.147	-0.235	0.140	0.134	0.275*	0.288*	0.025	0.040	0.093	0.157	0.242*	0.618***	–				
18. Peer support	-0.303*	0.238	0.05	-0.098	0.038	0.325**	-0.012	-0.102	0.041	0.057	0.089	0.321**	0.102	-0.180	0.170	0.344**	0.360**	–-			
19. Family importance	-0.032	-0.030	0.026	0.295*	0.141	-0.029	0.211	0.154	0.174	0.299*	0.054	0.073	0.205	0.253*	0.237*	0.440***	0.199	.112	–		
20. Teacher importance	0.209	-0.023	-0.023	0.432***	0.354**	-0.070	0.123	0.152	0.125	0.274*	0.119	0.017	0.378***	0.288*	0.242*	0.162	0.238*	.061	0.503***	–	
21. Peer importance	-0.017	0.211	0.009	0.269*	0.243*	0.193	-0.140	-0.147	-0.157	-0.036	0.059	0.111	0.231	-0.124	0.222	0.015	-0.051	.485***	0.345**	0.453***	–
22. Usefulness for peers	-0.149	0.250*	0.129	0.173	0.111	0.155	0.143	0.184	0.051	0.074	0.127	0.252*	0.236	0.036	0.003	0.330**	-0.032	.256*	0.452***	0.157	0.303*

** p<.05 ** p<.01 *** p<.001. Note: ITU = Intention to Use; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction; HLE = Home learning environment*

Again, and as would be expected, there were positive associations between those variables that comprised the TAM (intent to use, perceived usefulness, perceived ease of use, and perceived satisfaction). As with baseline and wave 1, digital self-efficacy use was associated with the variables that comprised the TAM. For example, higher scores on perceived satisfaction were associated with higher scores on perceived ease of use, perceived usefulness, and intent to use.

The amount of time using the device at school was positively associated with academic use at school and academic use at home and negatively associated with non-academic use at home. Spending more time using the device at school was associated with using the device more for academic use at school and at home and using the device for less non-academic activities at home. The strength of these associations was medium. As with wave 1 and wave 2, there was a large positive association between the amount of time spending using the device at home during weekdays and during the weekend such that great time spent using the device during weekdays was associated with greater device use during the weekend. There were small positive associations between non-academic use at home and weekday home use such that reporting spending more time using the device at home during weekdays was associated with greater non-academic use at home.

Digital self-efficacy was positively associated with technology comfort and negatively associated with non-academic use at home. Reporting higher levels of digital self-efficacy was associated with higher levels of technology comfort and lower levels of non-academic use at home. The strength of these associations ranged from small to medium. Focusing on the school engagement measures, value had small to medium positive associations with academic use at school, academic use at home, intention to use, perceived usefulness, perceived ease of use, and perceived satisfaction. Again, higher scores on value were associated with greater academic use at school and home, higher scores on intention to use,

perceived usefulness, perceived ease of use, and perceived satisfaction. Taking part had small to medium positive associations with all of the variables in the TAM, school use, and the home learning environment. Higher scores on taking part were associated with higher intent to use, perceived usefulness, perceived ease of use, perceived satisfaction, more time spend using the device in school, and a more positive learning environment at home. Taking part was also negatively associated with reports of non-academic use at home with higher scores for taking part associated with lower scores for non-academic use at home.

Similar to wave 2, wave 3 also included measures of family, teacher, and peer support and importance, and usefulness for peers. Family support was positively associated with teacher support and peer support with high scores of family support associated with high teacher and peer support, the strength of these relationships was medium. There was also a medium positive relationship between teacher support and peer support with high scores of teacher support associated with high scores of peer support.

There were small to medium positive associations between family support and some of the TAM variables, and technology comfort such that higher scores of family support were associated with higher levels of perceived usefulness, perceived ease of use, perceived satisfaction, and technology comfort. Teacher support was positively associated with perceived ease of use and perceived satisfaction. Having high levels of teacher support was associated with higher levels of perceived ease of use and perceived satisfaction. The strength of these associations was small. There was also a medium positive association between peer support and non-academic use at home and technology comfort, higher levels of peer support were associated with higher levels of non-academic use at home and technology comfort. Peer support was also negatively associated with school use such that higher levels of peer support was associated with lower school use; the strength of this relationship was medium.

The measures of importance of education for family, peers, and teachers were positively associated with each other and with academic use at school and usefulness for peers with small to medium associations between the variables. Higher scores of importance for education for family were associated with higher scores for peers and teachers, and higher scores of importance peers was associated with higher scores for teachers. Higher scores of importance for education for family, teachers, and peers were associated with higher scores for academic use at school and usefulness for peers. There were also small to medium positive associations between family importance, perceived satisfaction, taking part, and home learning environment with higher levels of family importance associated with higher levels of perceived satisfaction and taking part and a more positive home learning environment. There was a similar small to medium associations between teacher importance and perceived satisfaction, value, taking part, and home learning environment with higher levels of teacher importance associated with higher levels of perceived satisfaction, value, and taking part, and a more positive home learning environment. Peer importance was associated with academic use at school and academic use at home, with higher levels of peer importance associated with higher levels of academic use at school and at home; the strength of the association was small. There were small positive associations between usefulness for peers with weekday home use and technology comfort such that higher usefulness for peers was associated with greater weekday home use and higher technology comfort.

Technology acceptance model

To explore the TAM at baseline, structural equation modelling (SEM) was carried out using the Lavaan package in R (Rosseel, 2012). SEM enables relationships between variables to be examined while accounting for random measurement error (Grapentine, 2000). SEM was used to test two models. The first model explored the role of the home

learning environment, age, and digital self-efficacy on the TAM variables of perceived ease of use, perceived usefulness, perceived satisfaction, and intent to use at baseline. The second model represented an extension of the first model but integrated the school engagement variables.

Model 1 The role of the home learning environment, age, and digital self-efficacy and the TAM

The role of the home learning environment, age, and digital self-efficacy as predictors of the TAM were explored using SEM to test the model shown in Figure 7. Gender and age were included as covariates.

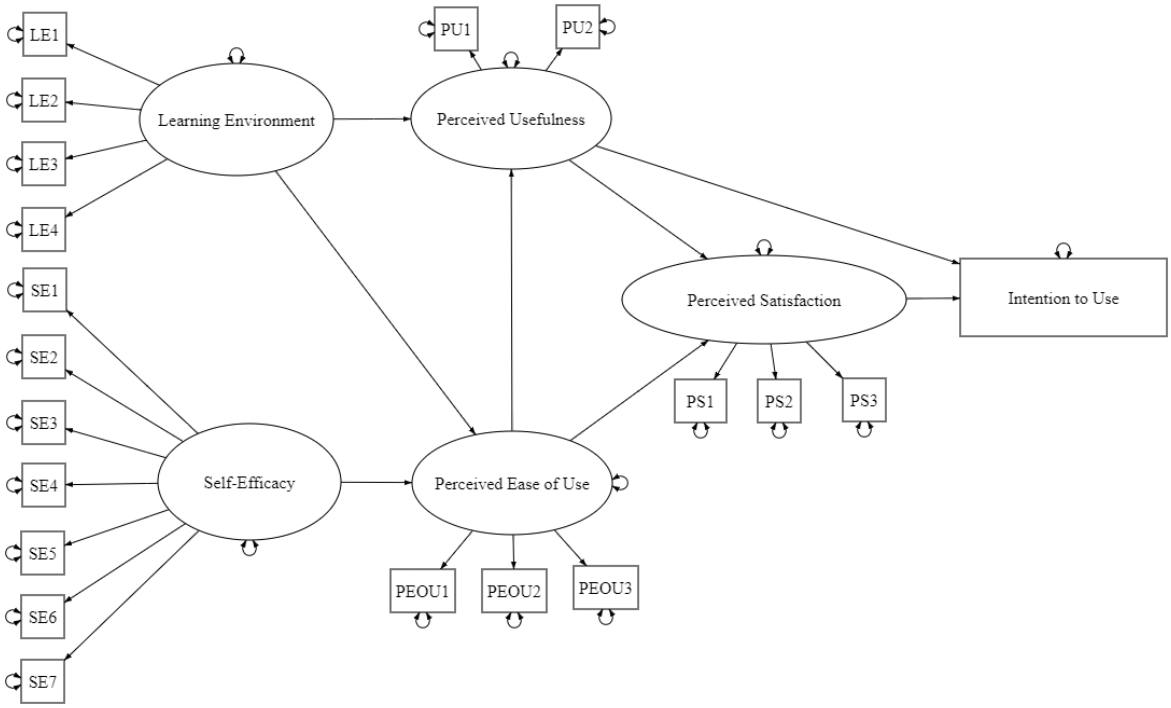

Figure 7. The SEM exploring the role of the home learning environment and digital self-efficacy as predictors of the TAM variables.

The model shown in Figure 7 was a good fit of the data with the Comparative Fit Index (CFI) = 0.905 exceeding the recommended value of 0.90 (Hu & Buttler, 1999), the Root Mean Square Error of Approximation (RMSEA) = 0.073 being below the recommended value of 0.08 (MacCallum et al., 1996), and SRMR = 0.077 being below the recommended 0.08 (Hu & Buttler, 1999). Moreover, as outlined in Table 21, the measurement model showed that with the exception of item seven from the digital self-efficacy scale that all items were appropriately loaded on the respective latent variable.

Table 21. Measurement model for the role of the home learning environment and self-efficacy with technology and the TAM variables

Scale	Item	Std. Loading	Loading	Std. Error	CI Lower	CI Upper
PU	PU1†	0.87	1.00			
	PU2	0.98	1.18	0.03	1.04	1.47
PEOU	PEOU1†	0.79	1.00			
	PEOU2	0.61	0.92	0.08	0.71	1.12
	PEOU3	0.75	0.84	0.08	0.52	1.11
PS	PS1†	0.94	1.00			
	PS2	0.95	1.03	0.02	0.96	1.14
	PS3	0.87	0.90	0.04	0.75	1.02
Digital self-efficacy	SE1†	0.61	1.00			
	SE2	0.68	1.25	0.08	0.98	1.61
	SE3	0.69	1.56	0.08	0.96	2.56
	SE4	0.55	0.83	0.10	0.61	1.10
	SE5	0.76	1.73	0.09	0.94	3.08
	SE6	0.79	1.81	0.09	1.03	3.25
	SE7	0.17	0.48	0.12	-0.14	1.32
Home learning environment	Suitable space†	0.90	1.00			
	Have desk	0.64	0.86	0.07	0.62	1.13
	Quiet space	0.70	0.89	0.06	0.67	1.14
	Sufficient internet	0.42	0.49	0.09	0.26	0.70

† Fixed parameter Note: CI Lower and CI Upper refer to the unstandardised 95% confidence intervals. Std. Estimate refers to standardised estimates and Std. Error refers to the unstandardised bootstrapped standard error. PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction

The analyses revealed several significant direct paths (see Table 22). Specifically, perceived satisfaction with the device and perceived usefulness positively predicted intent to use at baseline such that greater levels of perceived satisfaction with the device and greater levels of perceived usefulness predicted reporting a greater likelihood of intending to use the device. Further perceived ease of use positively predicted perceived satisfaction and perceived usefulness such that the higher the perceived ease of use, the higher the perceived satisfaction and the perceived usefulness. Age positively predicted perceived usefulness such that older participants thought that the device was more useful. Finally, digital self-efficacy positively predicted perceived ease of use: having higher levels of digital self-efficacy predicted higher levels of perceived ease of use. There were no other significant direct paths.

Table 22. Structural model for the role of the home learning environment, age, and self-efficacy with technology and the TAM variables

Variable	Predictor	Std. Estimate	Estimate	Std. Error	CI Lower	CI Upper
ITU	PS	0.34*	0.31	0.12	0.08	0.54
	PU	0.41***	0.39	0.14	0.17	0.7
	Age	0.05	0.03	0.05	-0.06	0.12
	Gender	-0.04	-0.07	0.10	-0.27	0.14
PS	PU	0.10	0.10	0.22	-0.41	0.46
	PEOU	0.76***	0.83	0.29	0.36	1.49
	Age	-0.09	-0.07	0.05	-0.16	0.03
	Gender	-0.02	-0.04	0.12	-0.29	0.18
PU	PEOU	0.78***	0.80	0.12	0.53	1.03
	Home learning environment	-0.14	-0.20	0.11	-0.44	0
	Age	0.16*	0.11	0.05	0.01	0.22
	Gender	-0.11	-0.19	0.12	-0.42	0.06
PEOU	Digital self-efficacy	0.44***	1.18	0.39	0.52	2.05
	Home learning environment	0.10	0.13	0.16	-0.17	0.48
	Age	-0.06	-0.04	0.06	-0.15	0.08
	Gender	0.00	0.01	0.14	-0.27	0.29

** p<.05 ** p<.01 *** p<.001 Note: CI Lower and CI Upper refer to the unstandardised 95% confidence intervals. Std. Estimate refers to standardised estimates and Std. Error refers to the unstandardised bootstrapped standard error. PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction*

In addition to the direct paths, the SEM analysis also revealed four mediation paths (see Table 23).

Table 23. Mediation paths for the role of the home learning environment, age, and digital self-efficacy and the TAM variables

Path	Std. Estimate	Estimate	Std. Error	CI Lower	CI Upper
PU-PS-ITU	0.03	0.03	0.07	-0.14	0.14
PEOU-PU-PS-ITU	0.03	0.02	0.06	-0.13	0.11
PEOU-PU-ITU	0.32***	0.31	0.10	0.14	0.54
PEOU-PS-ITU	0.26*	0.25	0.15	0.05	0.61
HLE-PU-PS-ITU	0.00	-0.01	0.01	-0.04	0.02
HLE-PEOU-PU-PS-ITU	0.00	0.00	0.01	-0.01	0.03
HLE-PEOU-PU-ITU	0.03	0.04	0.06	-0.06	0.17
HLE-PEOU-PS-ITU	0.03	0.03	0.04	-0.05	0.12
SE-PEOU-PU-PS-ITU	0.01	0.03	0.07	-0.15	0.13
DSE-PEOU-PU-ITU	0.14***	0.37	0.17	0.12	0.78
DSE-PEOU-PS-ITU	0.12*	0.30	0.18	0.05	0.75

** p<.05 ** p<.01 *** p<.001 Note: CI Lower and CI Upper refer to the unstandardised 95% confidence intervals. Std. Estimate refers to standardised estimates and Std. Error refers to the unstandardised bootstrapped standard error. HLE = Home Learning Environment; DSE = Digital Self-Efficacy; PU = Perceived Usefulness; PEOU = Perceived Ease Of Use; PS = Perceived Satisfaction*

As shown in Table 23 and Figure 8, there were four mediation paths. First, perceived usefulness mediated the relationship between perceived ease of use and intent to use such that higher levels of perceived ease of use positively predicted higher levels of perceived usefulness and higher levels of perceived usefulness, in turn, predicted higher levels of intent to use. Second, perceived satisfaction mediated the relationship between perceived ease of use and intent to use such that higher levels of perceived ease of use positively predicted higher levels of perceived satisfaction and higher levels of perceived satisfaction, predicted higher levels of intent to use. Third, perceived ease of use and perceived usefulness mediated the relationship between digital self-efficacy such that higher levels of digital self-efficacy

predicted higher levels of perceived ease of use, with higher levels of perceived ease of use predicting higher levels perceived usefulness and higher levels perceived usefulness predicting higher levels of intent to use. Fourth, perceived ease of use and perceived satisfaction mediated the relationship between self-efficacy and intent to use such that higher levels of digital self-efficacy predicated higher levels of perceived ease of use, and higher perceived ease of use predicted higher levels of perceived satisfaction and higher levels of perceived satisfaction in turn predicted higher levels of intent to use. There were no other significant mediation paths.

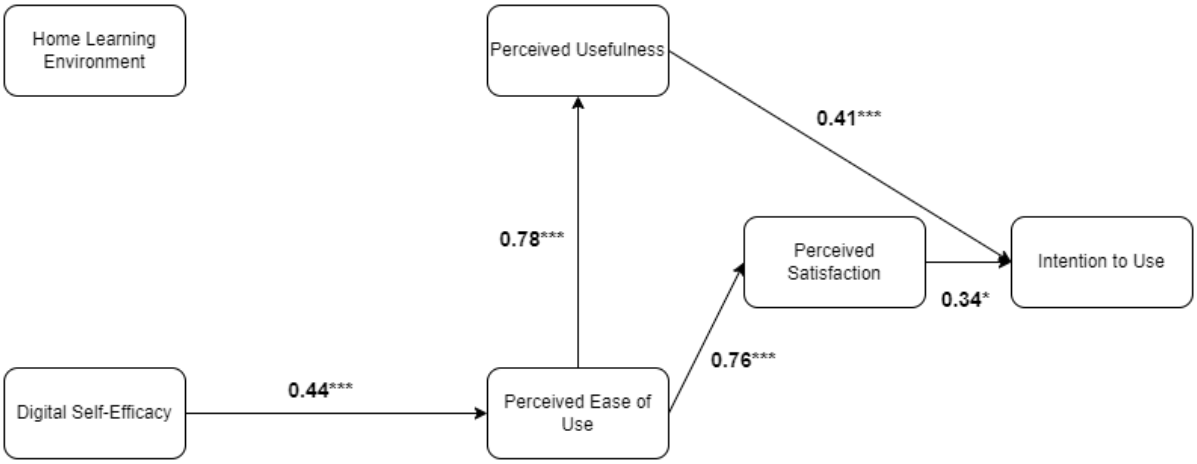

Figure 8. The significant mediation paths

Model 2 Including school engagement in the role the home learning environment, age, and digital self-efficacy and the TAM

The indicators of school engagement assessed as taking part and value were integrated into the model to test the model shown in Figure 9. Gender and age were included as covariates.

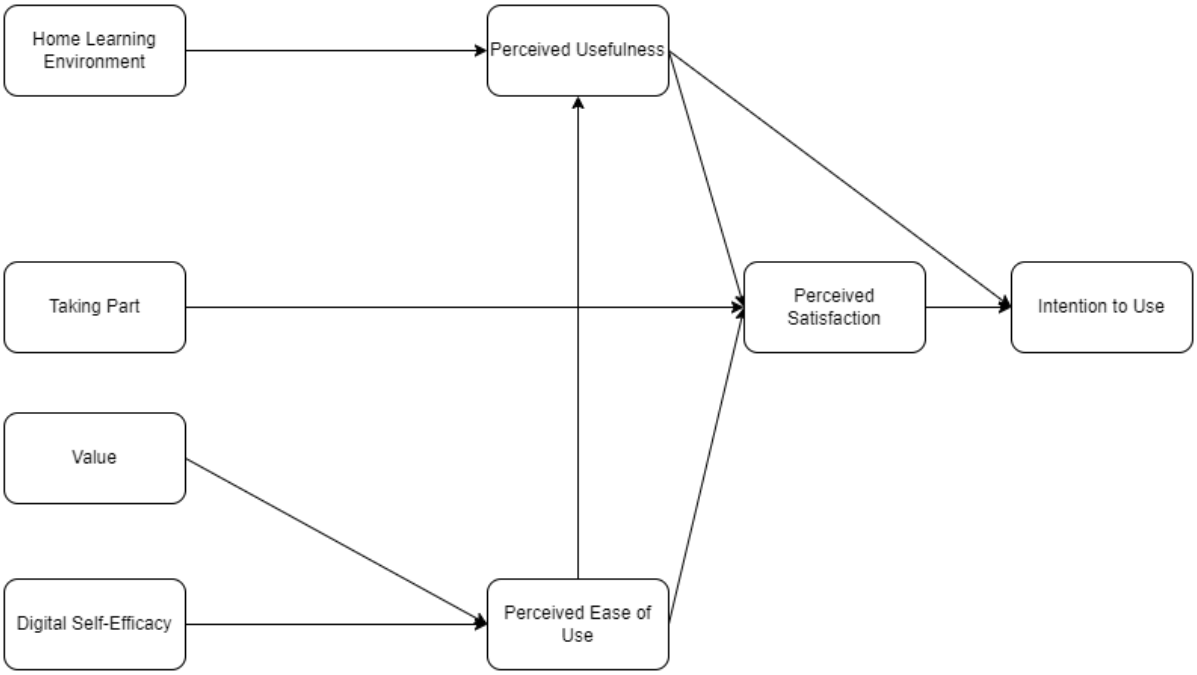

Figure 9. The SEM including value and taking part as indicators of school engagement and exploring the role of the home learning environment, age, and digital self-efficacy as predictors of the TAM.

The model shown in Figure 9 was a less good fit of the data with the Comparative Fit Index (CFI) = 0.847 being below the recommended value of 0.90 (Hu & Buttler, 1999), the Root Mean Square Error of Approximation (RMSEA) = 0.069 being below the recommended value of 0.08 (MacCallum, et al., 1996), and SRMR = 0.079 being below the recommended 0.80 (Hu & Buttler, 1999). Due to the CFI falling below the required 0.90, this model was not further explored.

Baseline intention to use device as a predictor of actual use

A series of regression analyses were performed to explore whether baseline intention to use the device predicted actual use across waves for measures of home use. The analyses did not consider school use as the learners would have had less control over these decisions. Age and gender were included as co-variates in the analyses. In first analyses baseline intent to use was entered as a predictor of time spend using the device during weekdays and the

weekend for waves 1, 2, and 3 (see Table 24). Intent to use the device at baseline did not predict actual weekday home use or weekend home use for any of the waves.

Table 24. Intent to use the device at baseline as a predictor of actual weekday and weekend use at home across waves

	W1 Weekday Home Use			**W1 Weekend Home Use**	
Predictors	Estimates	*p*		Estimates	*p*
(Intercept)	2.03	0.506		6.43	0.09
Baseline ITU	0.65	**0.013**		0.53	0.10
Age	-0.01	0.974		-0.21	0.31
Gender [Male]	0.4	0.35		0.33	0.51
Observations	71		Observations	75	
R^2 / R^2 adjusted	0.096 / 0.055		R^2 / R^2 adjusted	0.059 / 0.019	
F(3,67)	2.37	0.079	*F*(3,71)	1.48	0.226
	W2 Weekday Home Use			**W2 Weekend Home Use**	
Predictors	Estimates	*p*		Estimates	*p*
(Intercept)	-1.46	0.766		5.35	0.284
Baseline ITU	-0.15	0.742		-0.02	0.965
Age	0.56	0.151		0.06	0.88
Gender [Male]	-0.16	0.819		-0.19	0.785
Gender [Non-binary/third gender]	0.92	0.752		0.88	0.76
Observations	44		Observations	48	
R^2 / R^2 adjusted	0.065 / -0.031		R^2 / R^2 adjusted	0.007 / -0.086	
F(4,39)	0.68	0.611	*F*(4,43)	0.07	0.99
	W3 Weekday Home Use			**W3 Weekend Home Use**	
Predictors	Estimates	*p*		Estimates	*p*
(Intercept)	-1.18	0.75		4.14	0.256
Baseline ITU	0.23	0.38		-0.04	0.885
Age	0.37	0.114		0.16	0.5
Gender [Male]	0.74	0.175		0.94	0.067
Gender [Non-Binary/third gender]	0.5	0.823		-0.26	0.901
Observations	56		Observations	58	
R^2 / R^2 adjusted	0.085 / 0.013		R^2 / R^2 adjusted	0.065 / -0.005	
F(4,51)	1.18	0.332	*F*(4,53)	0.92	0.458

Note: Non-binary/third gender data was not available at wave 1

In the second analyses baseline intent to use was entered as a predictor of academic use at home and non-academic use at home for waves 1, 2, and 3 (see Table 25). Again, intent to use the device at baseline did not predict academic or non-academic use at home.

Table 25. Intent to use the device at baseline as a predictor of non-academic and academic use at home across waves

	W1 Non-Academic Use			**W1 Academic Use**	
Predictors	Estimates	*p*		Estimates	*p*
(Intercept)	5.4	0.67		28.91	0.051
Baseline ITU	2.42	**0.018**		0.97	0.429
Age	-0.46	0.521		-0.82	0.327
Gender [Male]	0.48	0.772		7.25	**<0.001**
Observations	67		Observations	65	
R^2 / R^2 adjusted	0.094 / 0.051		R^2 / R^2 adjusted	0.207 / 0.168	
F(3,63)	2.18	0.100	*F*(3,61)	5.3	**0.003**
	W2 Non-Academic Use			**W2 Academic Use**	
Predictors	Estimates	*p*		Estimates	*p*
(Intercept)	37.42	**0.009**		25.99	0.165
Baseline ITU	1.47	0.225		0.25	0.874
Age	-2.1	**0.049**		-0.21	0.882
Gender [Male]	-2.2	0.248		1.98	0.436
Observations	48		Observations	45	
R^2 / R^2 adjusted	0.113 / 0.053		R^2 / R^2 adjusted	0.016 / -0.056	
F(3,44)	1.87	0.148	*F*(3,41)	0.22	0.883
	W3 Non-Academic Use			**W3 Academic Use**	
Predictors	Estimates	*p*		Estimates	*p*
(Intercept)	4.03	0.762		10.7	0.546
Baseline ITU	0.98	0.305		-1.93	0.156
Age	0.22	0.796		1.92	0.075
Gender [Male]	0.85	0.663		3.58	0.144
Gender [Non-binary/third gender]	0.87	0.911		-7.74	0.452
Observations	54		Observations	54	
R^2 / R^2 adjusted	0.031 / -0.048		R^2 / R^2 adjusted	0.136 / 0.065	
F(4,49)	0.4	0.81	*F*(4,49)	1.92	0.122

Note: Non-binary/third gender data was not available at wave 1 or wave 2

Technology use a predictor of digital skills and school engagement

Linear mixed-effects models were fitted using the lmer4 package in R (Bates et al, 2015) to investigate the effects of Time (in months from baseline) and device use on digital skills (assessed as digital self-efficacy and technology comfort) and school engagement (assessed as value and taking part). Age and gender were included as control variables. Separate models were tested for school use, weekday home use and weekend home use. An interaction term between Time and device use was entered in addition to main effects. The predictors were centred prior to analysis to ensure that the coefficients were interpreted for reasonable ranges of the data in the interaction models. Participant ID was included as a random effect with random intercepts to account for repeated measurements, and school was included as a random effect with random intercepts to account for similarity between students from the same school. In cases of a singular fit, school was removed as a random effect. *p*-values were calculated based on conditional F-tests using the Kenward-Roger approximation to determine degrees of freedom, using the sjPlot package in R (Lüdecke, 2021). Marginal interaction effects were also plotted using sjPlot, with the levels of the moderator set to Low = Mean – 1 standard deviation, Average = Mean and High = Mean + 1 standard deviation.

Digital self-efficacy

Weekday school use. Entering school use and time as predictors of self-efficacy resulted in a significant interaction effect (see Table 26).

Table 26. Weekday school use and Time as predictors of digital self-efficacy

		Digital self-efficacy	
Predictors	*Estimates*	*CI*	*p*
(Intercept)	21.18	19.74 – 22.60	**<0.001**
Time	0.31	-0.10 – 0.71	0.133
School use	-0.11	-0.44 – 0.23	0.530
Age	0.33	-0.25 – 0.91	0.256
Gender [Male]	0.94	-0.58 – 2.45	0.218
Gender [Non-binary/third gender]	2.48	-1.85 – 6.81	0.259
Time * school use	0.14	0.01 – 0.27	**0.034**
Random Effects			
σ^2	7.84		
τ00 ID	3.39		
τ00 school	0.29		
ICC	0.32		
N school	8		
N ID	94		
Observations	154		
Marginal R^2 / Conditional R^2	0.100 / 0.388		

Plotting the interaction effect shows that higher use of the device in school predicted an increase in digital self-efficacy over time, with a more pronounced digital self-efficacy increase over time for the highest school use and more modest increases for average school use. The high school use groups may decrease in digital self-efficacy slightly over time but the confidence bands suggest high and average groups are not markedly different within the range of the data. (see Figure 10).

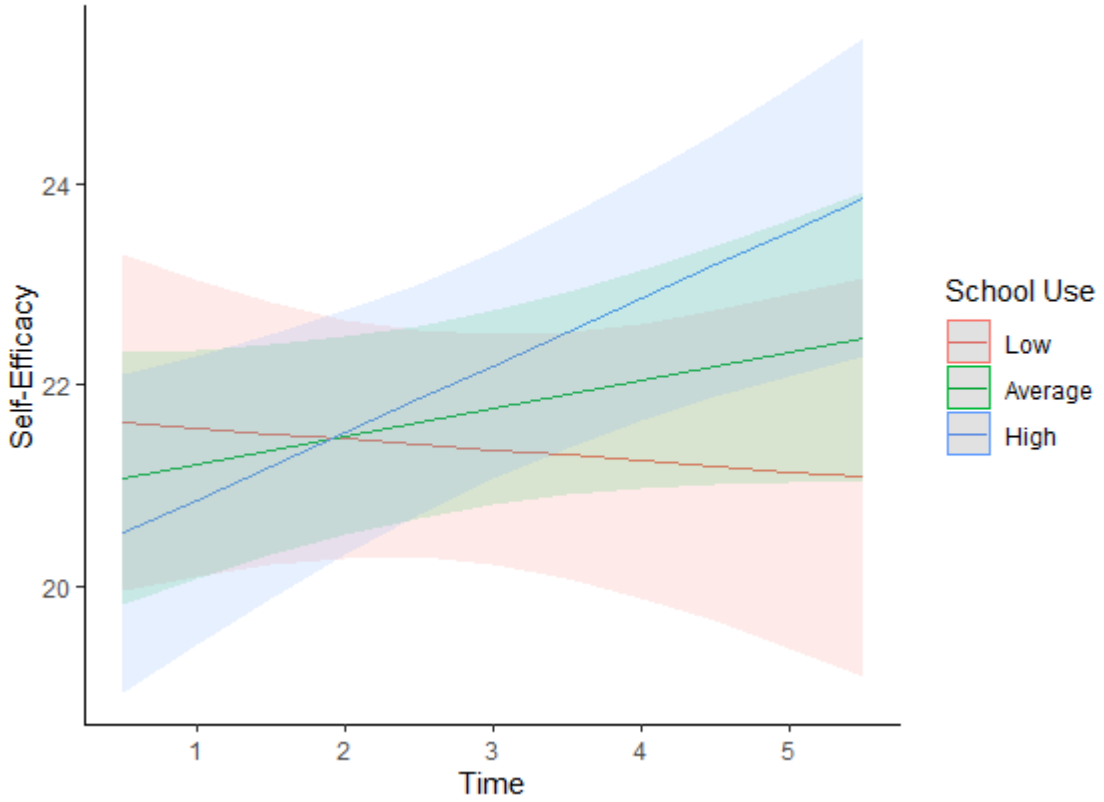

Figure 10. The interaction between Time in months since baseline and school use on digital self-efficacy.

Weekday home use. As shown in Table 27 there were significant main effects for both Time and weekday home use predicting digital self-efficacy, as well as a significant interaction between Time and weekday home use.

Table 27. Weekday home use and time as predictors of digital self-efficacy

		Digital self-efficacy	
Predictors	*Estimates*	*CI*	*p*
(Intercept)	20.83	19.82 – 21.83	**<0.001**
Time	0.44	0.09 – 0.79	**0.015**
Weekday home use	0.55	0.10 – 1.00	**0.017**
Age	0.36	-0.15 – 0.87	0.166
Gender [Male]	1.14	-0.12 – 2.39	0.075
Gender [Non-binary/third gender]	2.06	-2.19 – 6.31	0.339
Time * Weekday home use	-0.23	-0.43 – -0.03	**0.023**
Random Effects			
σ^2	7.02		
τ00 ID	4.23		
ICC	0.38		
N ID	96		
Observations	155		
Marginal R^2 / Conditional R^2	0.098 / 0.437		

Inspecting the plot of the marginal interaction effect (see Figure 11) suggests that those with low weekday home use initially had the lowest digital self-efficacy, and that their digital self-efficacy increased most rapidly over time, whereas those with average weekday home use had higher initial digital self-efficacy, and showed more gradual increases over time. Those with high weekday home use had the highest initial digital self-efficacy, and may decrease in digital self-efficacy marginally over time but the confidence bands suggest high and average groups are not markedly different within the range of the data.

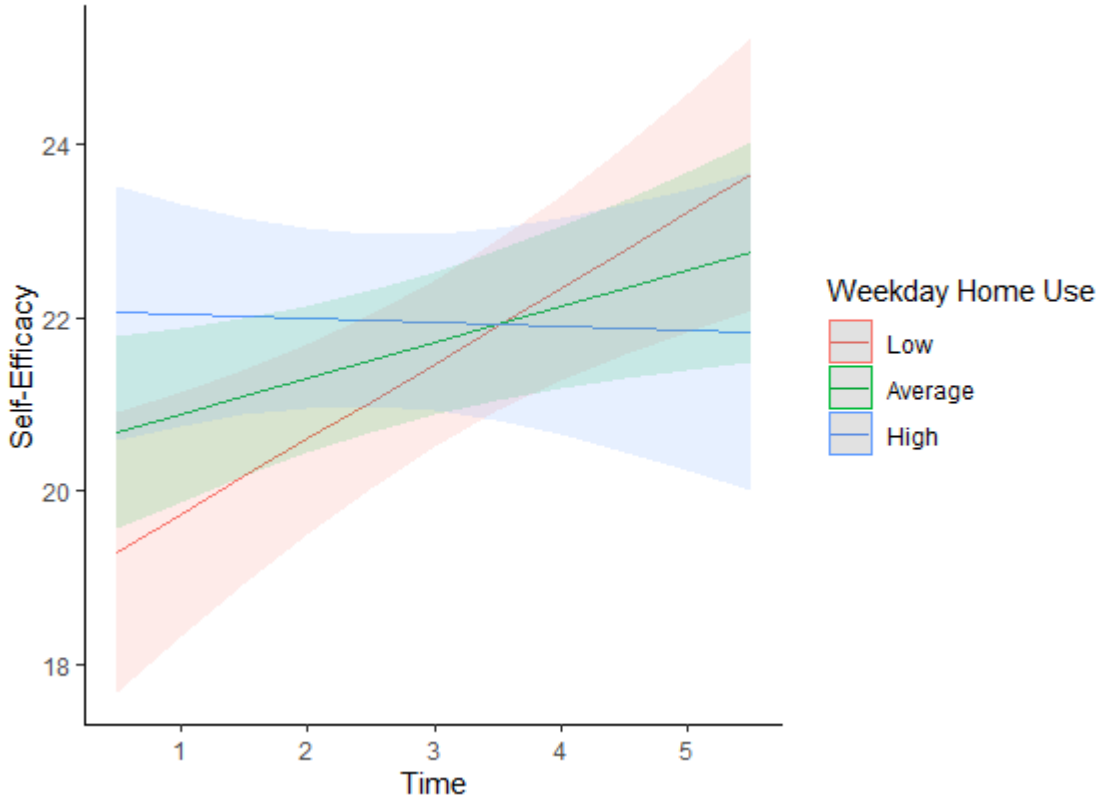

Figure 11. The interaction between Time in months since baseline and weekday home use on digital self-efficacy.

Weekend home use. There was a significant main effect for Time predicting digital self-efficacy, and a significant interaction between Time and weekend home use (see Table 28).

Table 28. Weekend home use and Time as predictors of digital self-efficacy

		Digital self-efficacy	
Predictors	*Estimates*	*CI*	*p*
(Intercept)	20.72	19.75 – 21.70	**<0.001**
Time	0.39	0.04 – 0.74	**0.029**
Weekend home use	0.35	-0.00 – 0.71	0.053
Age	0.41	-0.09 – 0.91	0.104
Gender [Male]	1.39	0.19 – 2.60	**0.023**
Gender [Non-binary/third gender]	3.17	-1.04 – 7.39	0.139
Time * Weekend home use	-0.19	-0.38 – -0.01	**0.036**
Random Effects			
σ^2	7.35		
τ00 ID	3.61		
ICC	0.33		
N ID	99		
Observations	163		
Marginal R^2 / Conditional R^2	0.095 / 0.393		

Inspecting the plot of the marginal interaction effect (see Figure 12) shows that those with low weekend home use initially had the lowest digital self-efficacy, and that their digital self-efficacy increased most rapidly over time, whereas those with average weekend home use had higher initial digital self-efficacy, and showed more modest changes over time. Those with high weekend home use had the highest initial digital self-efficacy, and may decrease in digital self-efficacy marginally over time but the confidence bands suggest high and average groups are not markedly different within the range of the data.

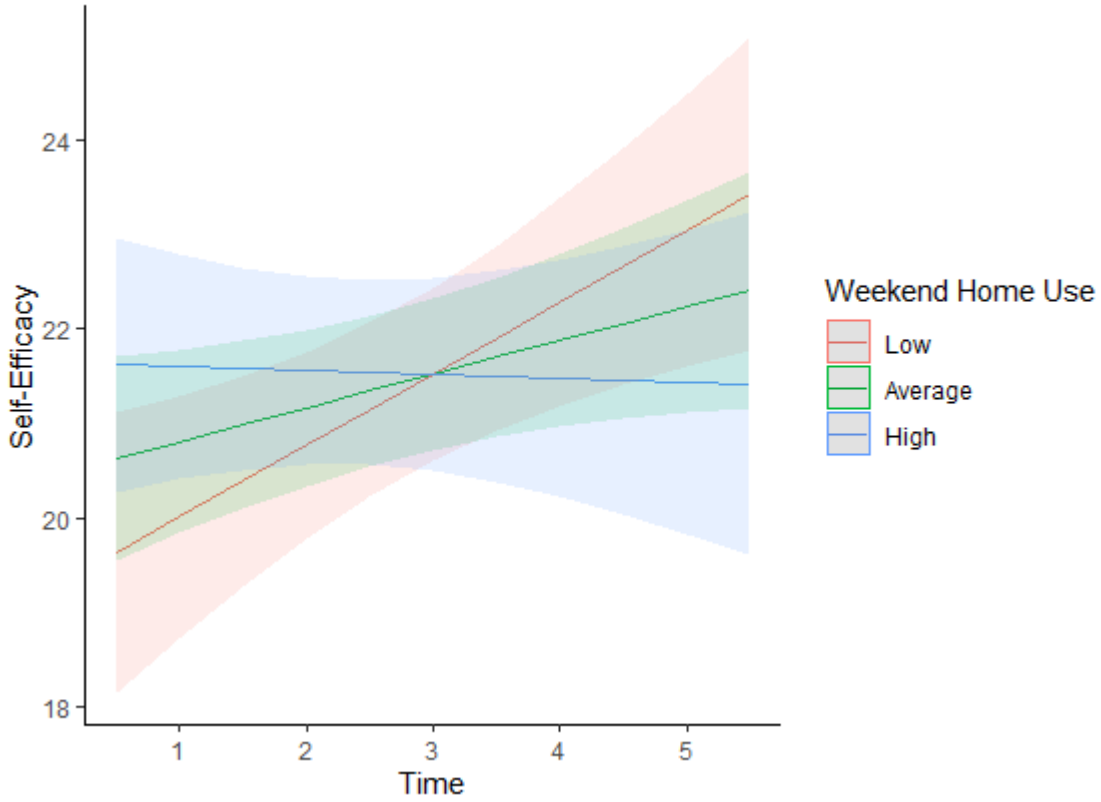

Figure 12. The interaction between Time in months since baseline and weekend home use on digital self-efficacy.

Value

For mixed effects models predicting value, primary language spoken at home was entered as a control variable, as there were differences in value at baseline between learners primarily speaking English at home and those primarily speaking another language at home (see Table 14, page 45). Entering Time as a predictor of value resulted in a non-significant main effect for Time, suggesting that value did not change over time (see Table 29).

Table 29. Time as a predictor of value

	Value		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	16.75	9.94 – 23.56	**<0.001**
Time	0.01	-0.22 – 0.24	0.924
Age	0.39	-0.07 – 0.84	0.094
Gender [Male]	0.83	-0.41 – 2.07	0.186
Gender [Non-binary/Third gender]	1.26	-1.88 – 4.41	0.43
Primary language [Other]	0.54	-0.77 – 1.85	0.414
Random Effects			
σ^2	9.73		
τ00 ID	9.55		
ICC	0.5		
N ID	159		
Observations	327		
Marginal R^2 / Conditional R^2	0.022 / 0.507		

Mixed-effects models with Time and device use variables entered as main and interaction effects resulted in no significant effects, suggesting device use did not impact value over time (see Table 30).

Table 30. Device use and time as predictors of value

	Value		
Predictors	*Estimates*	*CI*	*p*
	Model 1: School use		
(Intercept)	22.29	21.00 – 23.59	**<0.001**
Time	0	-0.40 – 0.40	0.99
School use	0.04	-0.31 – 0.39	0.837
Age	0.14	-0.54 – 0.82	0.678
Gender [Male]	1.88	0.23 – 3.52	**0.026**
Gender [Non-binary/third gender]	3.42	-1.77 – 8.60	0.195
First language [Other]	-1.17	-2.98 – 0.63	0.199
Time * school use	0.01	-0.13 – 0.15	0.879
Random Effects			
σ^2	8.59		
τ00 ID	9.18		
ICC	0.52		
N ID	92		
Observations	161		
Marginal R^2 / Conditional R^2	0.064 / 0.548		
	Model 2: Weekday home use		
(Intercept)	22.43	21.13 – 23.74	**<0.001**
Time	-0.02	-0.42 – 0.38	0.912
Weekday home use	-0.35	-0.89 – 0.19	0.203
Age	0.03	-0.64 – 0.70	0.922
Gender [Male]	2.09	0.42 – 3.76	**0.015**
Gender [Non-binary/third gender]	3.93	-1.32 – 9.19	0.141
First language [Other]	-0.95	-2.77 – 0.88	0.304
Time * weekday home use	0.12	-0.11 – 0.35	0.313
Random Effects			
σ^2	8.68		
τ00 ID	9.18		
ICC	0.51		
N ID	90		
Observations	159		
Marginal R^2 / Conditional R^2	0.075 / 0.550		
	Model 3: Weekend home use		
(Intercept)	22.52	21.22 – 23.82	**<0.001**
Time	0.01	-0.38 – 0.40	0.97
Weekend home use	-0.11	-0.53 – 0.31	0.612
Age	0.05	-0.62 – 0.72	0.888
Gender [Male]	1.86	0.21 – 3.51	**0.028**
Gender [Non-binary/third gender]	3.42	-1.86 – 8.70	0.203
First language [Other]	-1.11	-2.88 – 0.66	0.216
Time * weekend home use	0.02	-0.19 – 0.22	0.881
Random Effects			
σ^2	8.46		
τ00 ID	9.70		
ICC	0.53		
N ID	95		
Observations	167		
Marginal R^2 / Conditional R^2	0.058 / 0.561		

Taking Part

Entering Time as a predictor of taking part resulted in a significant main effect for Time, suggesting that taking part increased over the course of the scheme (see Table 31).

Table 31. Time as a predictor of taking part

		Taking part	
Predictors	*Estimates*	*CI*	*p*
(Intercept)	19.5	17.88 – 21.12	**<0.001**
Time	0.49	0.18 – 0.81	**0.002**
Age	-0.45	-1.14 – 0.25	0.202
Gender [Male]	-0.87	-2.52 – 0.79	0.301
Gender [Non-Binary/Third Gender]	3.23	-0.71 – 7.18	0.108
Random Effects			
σ^2	16.89		
τ00 ID	9.26		
τ00 school	1.56		
ICC	0.39		
N school	9		
N ID	149		
Observations	305		
Marginal R^2 / Conditional R^2	0.050 / 0.421		

However, the main effect of Time did not reach significance in models including the device use variables (and an interaction term), with these additional predictors also not reaching significance (see Table 32). This suggests that there is collinearity between Time and device use effects which are difficult to disentangle.

Table 32. Time and the device use variables as predictors of taking part

	Taking part		
Predictors	*Estimates*	*CI*	*p*
	Model 1: School use		
(Intercept)	20.51	17.99 – 23.03	**<0.001**
Time	-0.12	-0.60 – 0.36	0.617
School use	-0.1	-0.51 – 0.32	0.644
Age	-0.38	-1.32 – 0.56	0.418
Gender [Male]	-1.03	-3.35 – 1.28	0.376
Gender [Non-binary/third gender]	4.46	-1.48 – 10.40	0.14
Time * school use	0.06	-0.11 – 0.22	0.483
Random Effects			
σ^2	10.33		
τ00 ID	11.59		
τ00 school	3.18		
ICC	0.59		
N school	8		
N ID	87		
Observations	153		
Marginal R^2 / Conditional R^2	0.041 / 0.605		
	Model 2: Weekday home use		
(Intercept)	20.73	18.22 – 23.23	**<0.001**
Time	-0.01	-0.52 – 0.49	0.96
Weekday home use	-0.45	-1.08 – 0.17	0.155
Age	-0.6	-1.55 – 0.34	0.208
Gender [Male]	-1.44	-3.80 – 0.92	0.229
Gender [Non-binary/third gender]	4.72	-1.52 – 10.96	0.137
Time * weekday home use	0.2	-0.09 – 0.48	0.174
Random Effects			
σ^2	11.15		
τ00 ID	12.31		
τ00 school	2.98		
ICC	0.58		
N school	8		
N ID	88		
Observations	152		
Marginal R^2 / Conditional R^2	0.061 / 0.604		
	Model 3: Weekend home use		
(Intercept)	20.7	18.22 – 23.19	**<0.001**
Time	-0.08	-0.58 – 0.43	0.764
Weekend home use	-0.13	-0.64 – 0.37	0.602
Age	-0.67	-1.61 – 0.26	0.153
Gender [Male]	-1.42	-3.74 – 0.90	0.226
Gender [Non-binary/third gender]	4.17	-2.09 – 10.43	0.19
Time * weekend home use	0.11	-0.15 – 0.36	0.409
Random Effects			
σ^2	11.89		
τ00 ID	11.14		
τ00 school	3.01		
ICC	0.54		
N school	8		
N ID	91		
Observations	160		
Marginal R^2 / Conditional R^2	0.055 / 0.568		

Technology comfort

For mixed effects models predicting technology comfort, primary language spoken at home was entered as a control variable, as there were differences in technology comfort at baseline between learners primarily speaking English at home and those primarily speaking another language at home (see Table 14, page 45). Entering time as a predictor of technology comfort did not result in a significant effect, suggesting that reported levels of technology comfort did not change over the course of the scheme (see. Table 33).

Table 33. Time as a predictor of technology comfort

	Technology comfort		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	2.21	1.27 – 3.16	**<0.001**
Time	0.01	-0.03 – 0.04	0.693
Age	0.08	0.01 – 0.14	**0.019**
Gender [Male]	0.18	0.01 – 0.35	**0.043**
Gender [Non-binary/third gender]	0.31	-0.17 – 0.80	0.207
First language [Other]	0.16	-0.02 – 0.35	0.082
Random Effects			
σ^2	0.24		
τ00 ID	0.17		
ICC	0.41		
N ID	161		
Observations	339		
Marginal R^2 / Conditional R^2	0.052 / 0.438		

Entering device use variables resulted in no significant main effects or interaction effects with time, suggesting that device use did not affect reported technology comfort levels over time (see Table 34).

Table 34. Time and the device use variables as predictors of technology comfort

	Technology comfort		
Predictors	*Estimates*	*CI*	*p*
	Model 1: School use		
(Intercept)	3.34	3.08 – 3.61	**<0.001**
Time	-0.01	-0.07 – 0.05	0.824
School use	0.03	-0.02 – 0.08	0.225
Age	0.06	-0.04 – 0.17	0.233
Gender [Male]	0.34	0.07 – 0.62	**0.014**
Gender [Non-binary/third gender]	0.24	-0.55 – 1.02	0.556
First language [Other]	0.04	-0.23 – 0.30	0.793
Time * school use	-0.01	-0.03 – 0.01	0.388
Random Effects			
σ^2	0.17		
τ00 ID	0.17		
τ00 school	0.02		
ICC	0.52		
N ID	93		
N school	8		
Observations	165		
Marginal R^2 / Conditional R^2	0.097 / 0.571		
	Model 2: Weekday home use		
(Intercept)	3.35	3.11 – 3.59	**<0.001**
Time	0.01	-0.04 – 0.07	0.651
Weekday home use	0.05	-0.02 – 0.12	0.162
Age	0.06	-0.04 – 0.15	0.246
Gender [Male]	0.23	-0.05 – 0.50	0.1
Gender [Non-binary/third gender]	-0.05	-0.81 – 0.71	0.894
First language [Other]	0.07	-0.20 – 0.33	0.621
Time * weekday home use	0.02	-0.01 – 0.05	0.181
Random Effects			
σ^2	0.15		
τ00 ID	0.19		
τ00 school	0		
ICC	0.56		
N ID	94		
N school	8		
Observations	164		
Marginal R^2 / Conditional R^2	0.144 / 0.620		
	Model 3: Weekend home use		
(Intercept)	3.36	3.18 – 3.53	**<0.001**
Time	0	-0.05 – 0.05	0.981
Weekend home use	0.03	-0.02 – 0.09	0.231
Age	0.07	-0.02 – 0.16	0.135
Gender [Male]	0.26	0.03 – 0.48	**0.026**
Gender [Non-binary/third gender]	-0.18	-0.94 – 0.59	0.651
First language [Other]	0.03	-0.21 – 0.27	0.781
Time * weekend home use	0.03	-0.00 – 0.05	0.058
Random Effects			
σ^2	0.16		
τ00 ID	0.19		
ICC	0.55		
N ID	99		
Observations	175		
Marginal R^2 / Conditional R^2	0.131 / 0.605		

Summary of results from learners

When considering the results from learners it is important to acknowledge that there was variation in the response rates across the waves, with numbers reducing from baseline and some schools participating in only some of the waves. However, when responses were compared for those who participated only at baseline versus those who participated in each subsequent wave, there was no systematic attrition at the level of the schools.

At baseline, there was some evidence of variation according to learner characteristic. For example, those learners who reported that they primarily spoke a language other than English at home scored significantly higher on the value measure of school engagement compared to those learners who reported that they primarily spoke English at home. This finding is consistent with literature which has reported differences in the value of education in relation to ethnicity (Spera et al., 2009). Also, being older was associated with higher levels of perceived usefulness, higher technology comfort, higher academic use intention, and a more positive learning environment. The results for age suggest that learners in the current evaluation who were older had higher levels of digital skills and regarded the usefulness of the device as greater which contradicts some previous research that suggests perceived usefulness reduces with age (Arndt & Peterson, 2018). However, the current findings may reflect that the devices the learners received were more closely aligned to those needed for a more advanced curriculum (see Arndt & Peterson, 2018). Despite previous research reporting that boys have higher digital learning preferences and a higher wish for digital schoolwork than girls (Mädamürk et al. 2021), there were no significant gender differences between learners for the variables of interest at baseline.

When considering the pattern of associations among the variables of interest at the various timepoints, there was consistent evidence of positive and strong associations between those variables that comprised the TAM. Specifically, there was associations between perceived

ease of use, perceived usefulness, perceived satisfaction, and intention to use which are consistent with the relationships identified in the TAM (Davis, 1986, 1989). However, there were variations in the relationships between the TAM variables and other variables across waves. For example, at wave 1 there was no association between the TAM variables and non-academic use at home, but associations were found between academic use at home and school and the perceived usefulness of the device. Together, this finding suggests that when devices were perceived to be useful by respondents, they also reported that they would use the device more for academic purposes at home and at school. Also of note was a negative association at wave 2 between the amount of time spent using the device and perceived ease of use suggesting that the more time learners used the device, the lower their reported perceived ease of use. Although this association may be unexpected, the finding may reflect that as learners engage in more complex tasks, they regard the device as less easy to use. Previous research has identified an equally complex relationship between device use and perceived ease of use, especially with age. For example, Arndt and Peterson (2018) argue that negative relationships between age and perceived ease of use can be explained by learners experiencing more advanced curriculum which required more advanced technology. In the current evaluation, the negative relationship between ease of use and device use could reflect that learners were being asked to engage with more complex learning activities using the device as they progressed through the academic year.

Structural equation modelling was used to explore the hypothesised relationships between the TAM variables at baseline. As identified in the previous literature (e.g., Granić and Marangunić, 2019) significant pathways between the variables were identified. For example, direct paths were found between perceived satisfaction, perceived usefulness, and intent to use with greater perceived satisfaction with the device and perceived usefulness positively predicting intent to use. Together, these findings suggest that a learner's intent to use the

device at the start of the Tech4Schools intervention was informed by their perceived satisfaction with the device and how useful they believed the device to be. Relatedly, perceived ease of use positively predicted satisfaction and perceived usefulness with seeing the device as easier to use leading to higher levels of satisfaction with the device and a greater sense that the device is useful. Consequently, these direct paths suggest that ensuring that learners are appropriately briefed with regards to how to use the device, ensuring the device aligns with their needs, and highlighting how the device will be used could further promote their intent to use.

Digital self-efficacy was also a significant predictor of ease of use at baseline with higher levels of digital self-efficacy positively predicting perceived ease of use. Similarly, digital self-efficacy also predicted perceived ease of use which in turn predicted perceived usefulness, and perceived usefulness predicted intent to use. Relatedly, digital self-efficacy also predicted perceived ease of use which in turn predicted perceived satisfaction and perceived satisfaction predicted intent to use. Together, these findings align with previous research that has highlighted the importance of digital self-efficacy for engaging with digital technology (e.g., Ulfert-Blank & Schmidt, 2022). Therefore, understanding more about learners' digital self-efficacy could be important in future iterations of the Tech4School scheme.

The home learning environment of learners and the learners' self-reported school engagement did not serve as predictors of the variables of the TAM. Previous research has highlighted the importance of the home learning environment (Lehrl et al., 2020) and school engagement (Wonglorsaichon et al., 2014) for learning. However, it is important to acknowledge that what we may think of as an appropriate home learning environment (e.g., suitable space, a desk etc.) may not be viewed in the same way by our learners.

Understanding the factors that are important for intent to use the device is important because previous research has shown intent to use predicts usage (Lee et al., 2003). However, in the current evaluation there was no relationship between the intent use and actual use across any of the waves. Although contrary to expectation, as identified in the social psychology literature, the relationship between intended behaviour and actual behaviour is often large with intentions "*translated into action approximately one-half of the time*" (Sheeran & Webb, 2016, p.511).

Liner mixed effect models were used to investigate the effect of time (in months from baseline) and device use on digital self-efficacy and school engagement assessed as value and taking part. Higher use of the device in school predicted an increase in digital self-efficacy over time. Those learners with low weekday and weekend home use initially had the lowest digital self-efficacy and their digital self-efficacy increased most rapidly over time. Together, these findings suggest that the device must be used at a relatively high level to impact learners' digital self-efficacy. Indeed, previous research has highlighted the importance of developing digital self-efficacy when considering how users engage with technology (Bonanati & Buhl, 2022). However, for technology comfort there were no significant effects for time or device use.

When looking at changes in the school engagement variables over time, for value there were no significant effects suggesting that reports of value for education did not change over time or with differing device use. For taking part as an indicator of school engagement the main effect for time suggested that taking part increased over the course of the Tech4Schools scheme. However, when device use was included in the model time did not reach significance suggesting a collinearity effect between time and device use which is difficult to disentangle. Therefore, it seems that involvement in the Tech4School scheme had limited benefits for the measures of school engagement used in the current evaluation.

Online surveys with parents

Method

Study design

An online/telephone interview design was initially planned to explore parents' perceptions of the Tech4School scheme. The Digital Poverty Alliance contacted eligible schools who were provided with details and asked to share these with potential participants. However, due to a lack of response from parents, the interview schedule was adapted so that similar questions could be asked through an online survey hosted on the Qualtrics software (Qualtrics, Provo, UT).

Participants

Three parents completed the online survey.

Study materials

A semi-structured interview schedule was developed, in collaboration with the Digital Poverty Alliance, to facilitate objectivity and enhance trustworthiness in the research (Kallio et al., 2016). The interview schedule included nine questions that explored topics such as access to technology in the home (e.g., *"Can you begin by describing what access to technology you have at home?"*), their knowledge of the Tech4School scheme (e.g., "*What do you know about the Tech4Schools Scheme?"*), the perceived impact of the scheme on members of the household (e.g., *"How do you think the Tech4School device may influence your child, family, others in the household?"*), the benefits of the intervention (e.g., "*Based on your experiences of the Tech4Schools scheme, do you think are any benefits of the scheme*?"), the challenges of the intervention (e.g., *"Based on your experiences of the*

Tech4Schools scheme, do you think there are any challenges of the scheme?"), and how the scheme could be developed (e.g., *"If Tech4Schools were to extend this scheme to other children, what do you think they need to be aware of?*"). Following challenges in recruiting parents to participate in an interview, six questions were selected for the online survey. Together the questions focused on access to technology in the home environment, knowledge of the scheme, the benefits and impact of the intervention, the challenges of the intervention, and lessons for the future delivery.

Procedure

Favourable ethical approval for this study was obtained from the Schools of Business, Law, and Social Sciences Research Ethics Committee at Nottingham Trent University. The Digital Poverty Alliance initially asked schools to consider sharing information with eligible parents about the research. Prior to participating in the research, participants were given information about the nature of the research and informed that decisions around participation would not influence their child(ren)'s engagement with the Tech4Schools scheme and asked to give their consent.

Results

Due to the very small number of responses from parents, a brief summary of the responses will be provided. However, the summary should be treated with caution because of the associated sample size. All the parents reported access to a laptop at home, with two mentioning mobile phones, and one mentioning a PS4 and an iPad. When asked about their knowledge of the scheme one parent said "*They provide free laptops to less privilege"* (Participant 3) whereas the other two reported "*not a lot"* (Participant 1) or "*not much knowledge"* (Participant 2). All the parents felt that the Tech4Schools scheme had influenced

members of the household, with examples including supporting the completion of homework more efficiently and improving learning. The parents also said that they thought there were "*quite a lot of benefits"* (Participant 3) of the Tech4Schools scheme including giving young people the independence as they did not have to share a laptop. When asked about the challenges of the scheme and how the scheme could be extended, the parents reported no challenges and said that they "*don't know"* (Participant 3) how the scheme could be developed. However, one parent hinted at considering the eligibility criteria of the Tech4Schools scheme if it was to be extended saying "*The necessity, whether the children need the tech or not"* (Participant 2).

Summary of results from parents

Due to the small sample of parents, the analyses should be treated with caution. However, the small sample of parents appeared to hold overwhelmingly positive views about the Tech4School scheme. For example, parents regarded the scheme as beneficial and suggested that the access to the device supported young people's completion of homework and impacted their learning opportunities. This finding is consistent with previous research that has identified similar relationships between access to technology enhancing learning opportunities (Harju et al., 2019; Mädamürk et al., 2021). Relatedly, some of the parents also highlighted how through the scheme providing personal laptops it overcame some of the challenges associated with device sharing. Device sharing was something that was highlighted as a particular challenge for many families and learners during the pandemic (Montacute & Cullinane, 2021).

Online focus groups and online surveys with teachers

Methods

Study design

An online focus group/interview study was initially developed, in consultation with the Digital Poverty Alliance, to provide teachers with the opportunity to discuss their experiences of the Tech4Schools scheme. However, as with the parent data collection due to challenges recruiting teachers, the focus group/interview schedule was adapted such that similar questions could be asked through an online survey hosted on the Qualtrics software (Qualtrics, Provo, UT).

Participants

Four teachers from one school agreed to participate in a focus group. Four teachers completed the online survey.

Study materials

As with the parent study, a semi-structured focus group schedule was developed, in collaboration with the Digital Poverty Alliance, to facilitate objectivity and enhance trustworthiness in the research (Kallio et al., 2016). The focus group schedule included nine questions in in total that explored topics such as knowledge of the Tech4School scheme (e.g., "*What do you know about the Tech4Schools Scheme"*), the benefits of the intervention (e.g., "*Thinking about the Tech4Schools scheme, what do you think are the benefits of the scheme*"?), the challenges of the intervention (*Thinking about the Tech4Schools scheme, what do you think are the challenges of the scheme?*"), and the perceived impact of the intervention (e.g., "*Thinking about the Tech4Schools scheme, how has this influenced your practice?*"). Following challenges in recruiting teachers to participate in a focus group, five

questions were selected for the online survey. Together the questions focused on the benefits of the intervention, the challenges of the intervention, and the perceived impact of the intervention.

Procedure

Favourable ethical approval for this study was obtained from the Schools of Business, Law, and Social Sciences Research Ethics Committee at Nottingham Trent University. Teachers at schools participating in the Tech4Schools scheme were initially invited by the Digital Poverty Alliance to consider participating in a focus group and then subsequently invited to consider participating in an online survey. Prior to participating in the research, participants were given information about the nature of the research and informed that decisions around participation would not influence their engagement with the Tech4Schools scheme and asked to give their consent. The focus group took place over Microsoft Teams and was recorded and transcribed using Teams automatic transcription. The recording was then used to check the accuracy of the transcript. The focus group lasted 32 minutes and 38 seconds.

Analysis

Data collected from the focus group and surveys were analysed using an approach informed by reflexive thematic analysis. Reflexive thematic analysis can be used to "*provide coherent and compelling interpretation of the data, grounded in the data*" (Braun et al., 2019, p848). The six stages of reflexive thematic analysis were followed when analysing the data: (1) familiarisation, (2) generating codes, (3) constructing themes, (4) reviewing themes, (5) defining and naming themes, and (6) generating a report. Specifically, the transcript and survey responses were read and reread for the purpose of familiarisation, following which

initial codes representing distinct ideas and concepts were generated. These initial codes were then organised into broader themes representing clusters of interrelated codes. These themes were checked against their codes to ensure a good fit, and then given names succinctly describing the ideas they represented. NVivo (QSR) was used to support the analysis of the focus group and surveys.

Results

The thematic analysis of the focus group and survey data resulted in three main themes: difficulties before the scheme, benefits of the scheme, and limitations of the scheme (see Figure 13).

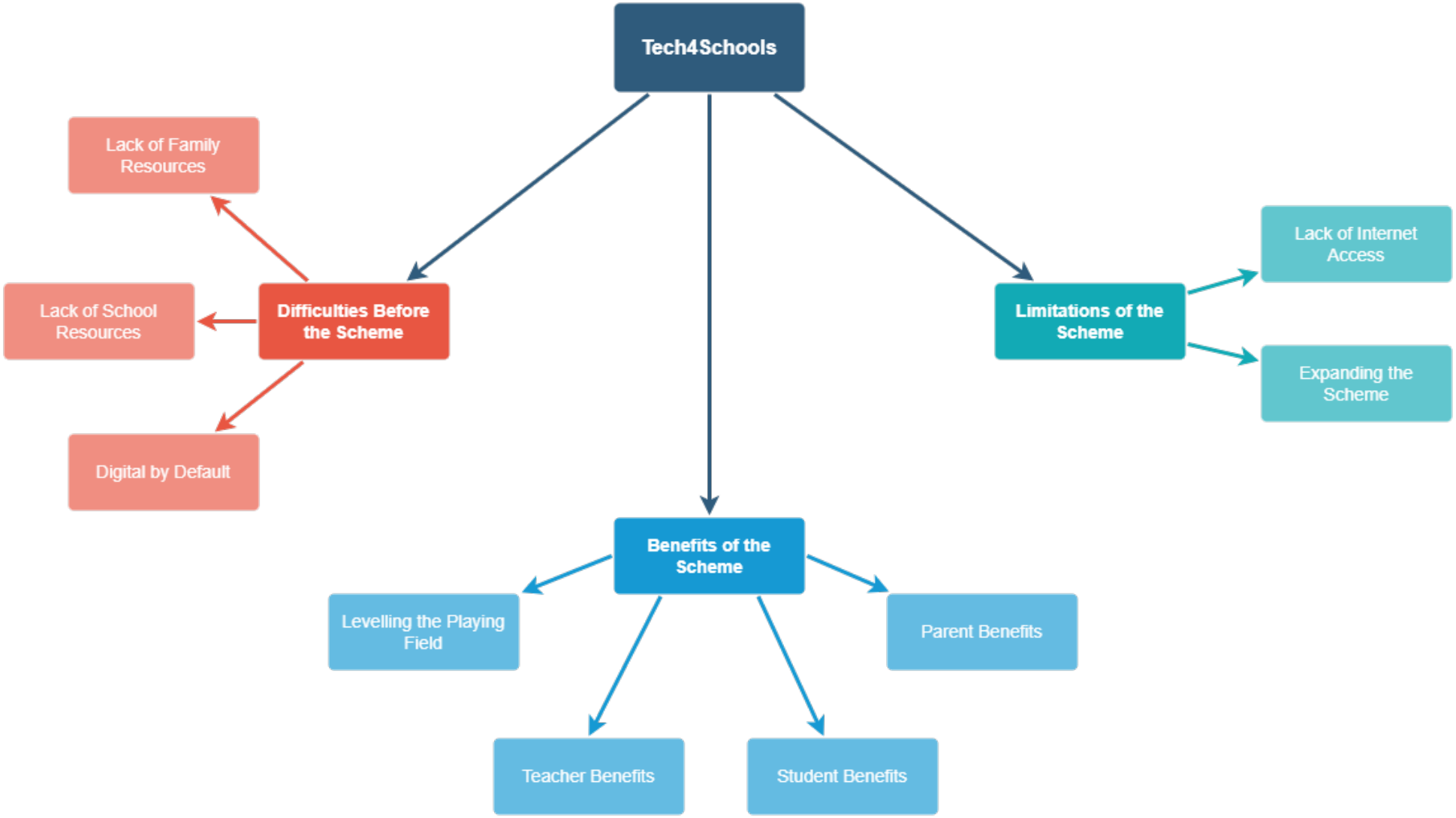

Figure 13. The thematic map reflecting the teacher data

Difficulties before the scheme

According to the teachers, a number of difficulties existed before the implementation of the Tech4Schools Scheme. These difficulties mostly revolved around a lack of resources in an increasingly digital learning environment. Teachers reported a lack of resources prior to the Tech4Schools scheme, both for the schools and the students and their families. Consequently, learners' access to digital devices was perceived to be limited. Moreover, there was a perception that even where devices were available, there were often challenges around accessing the device. For example, teachers talked about how for some of their leaners there was the need to share the device between the entire family, with siblings, and with parents. Family poverty was cited as the primary reason for this lack of access to devices at home.

> *"During lockdown for example, we noticed people who had to share with siblings. Yeah, they were very limited, but where one family might have a laptop, they had limited access to it over the course of the day because they had to share with siblings. That is still the case, by the way, but obviously we don't have statistics to tell you exactly what the situation is like for our pupils, but we do know, you know, poverty is a playing a part in our pupil's lives and the pupil's that received the laptop, they do not have any access to a laptop or any other device other than a phone at home."*
> (Participant 1)

The teachers described how the problems were exacerbated during the Covid-19 lockdowns.

> *"It became very apparent during the lockdowns that some students and families had difficulties, especially in the area where we live. It's not the richest of areas and parents could not provide access. You know, if three or four of your kids have to log in and you've got two devices or even one. It did create quite a problem for some, for a good number of families."* (Participant 3)

The teachers recognised and highlighted the primary role of digital resources in learning, with education being 'digital by default'. Therefore, this lack of access to digital devices interfered with some students' ability to access homework and key online learning resources.

> *"Sometimes they'd come to lessons obviously not able to complete the homework that we have posted online and [interviewer name] another thing we do heavily rely on people to have technology and internet now, everything we do we kind of post it online through [platform]. Now, we do give them physical hard copies and booklets, and exactly whatever it is that they need, but often with that, we put the mark scheme online. So we would ask them to go and you know self-assess their own homework and access online. So some of our people who come back and say, they, they don't have access to Internet home they don't have laptops, they have to share laptops, so yeah, they have limited access to technology at home. […] And there's a lot more resources that's coming up that*

is online, you know Seneca learning, GCSE pod, these are a lot of them subscriptions that we as a school have made and they are quite expensive and we know they're very useful as well. But we also have some of our pupils unfortunately don't have devices to access those online platforms." (Participant 3)

Some of the teachers talked how when learners lacked access to these online platforms and resources it meant that teachers thought that the leaners' work quality suffered as a consequence of this lack of access.

Oh the quality I'd say. You know they need to have paper or pens to write it all up. They can't really do that much research. Also software where we would have to be able to provide the Photoshop or Adobe Premiere we can't do it because they don't actually have the equipment to download it on." (Participant 4)

The teachers also talked about how it was often difficult for them to know when students lacked access to these resources, as for some students, there was a sense of embarrassment around not having the digital resources that are seen as necessary for education.

"Especially when a lot of the students feel like kind of embarrassed, especially the ones that do come up from deprived backgrounds they felt almost ashamed to say they don't have these… you think that you consider these necessary resources." (Participant 4)

"But you know what it is? The kids, they would be afraid to even come forward to say they don't have a laptop because we are at the time now where I think it should be a given, you know, everyone to have everything at home, but it's not the case." (Participant 3)

In addition to this lack of student resources, the teachers also recognised that schools also were limited in what resources they had to offer the learners, particularly in terms of having enough devices to go around. For example, one participant talked about how "*the school's existing devices are shared so less opportunities to use them regularly.*" (Participant 6). The participants also talked about how they were trying increase resource availability.

"As a school we have been trying to work towards 1-to-1 device allocation for both tablet and PC but with hardware aging so quickly we are constantly chasing to keep up." (Participant 6)

Further, in addition to the resource availability, there was also some evidence that teachers recognised the challenges of trying to keep the resources that were available up to date.

"We have laptops within the school itself, laptop trolleys, but obviously it's limited in number. And also we have some, we have [number] IT rooms, dedicated IT rooms, but we also have some rooms with a smaller number of computers across the department, but not as many. So not every class has computers." (Participant 2)

Benefits of the scheme

The teachers reported many benefits of the Tech4Schools scheme across a range of stakeholders. These stakeholders included the teachers themselves as educators, the learners, and their parents. A key benefit was a 'levelling of the playing field' between learners, allowing all students to access digital resources and complete work at home that requires a laptop.

> *"Yeah, I think it's bridging the gap because obviously there's a digital divide, especially for the area that we live in. I think this programme, I think that the aim is to kind of close the gap between the, well, the haves and have nots so that the outcome for students is on a level ground."* (Participant 2)

Access to devices was also seen as a way to promote independent learning and enabling all learners to complete required learning activities. This was also supported by having the required software installed on the devices prior to students receiving them.

> *"We know that the pupils that did not have any laptops now have a laptop, so we can sort of approach, any independent learning, knowing that all pupils can access whatever it is they need to access at home. So prior to the laptops we would know six, maybe six pupils in one class they did, they won't be able to complete specific tasks because they don't have the required software or laptop at home for example I've got a teacher who teaches media studies and as part of*

that curriculum, they do need Photoshop. And when we received the laptops, we asked the IT technicians to install Photoshop because we do have the licence for it. But pupils often don't have their devices actually use Photoshop. So when we distribute the laptops, we install all the software they need. And so we have that accessibility." (Participant 2)

The teachers also acknowledged that access to the devices was particularly helpful for those who were preparing for GCSEs and exam preparation.

"All we can say is the fact that during the last few months build up to the GCSE, we knew that the pupils were in good hands and they got everything they need to access the learning and because like I said at this school, we have a lot of emphasis on e-learning and putting a lot of work online. So based on that, because we knew that pupils will not have anything, any barrier basically I hope." (Participant 1)

"It has been really useful as I have been able to upload work to Google Classroom for students and they are able to access the work during the exams." (Participant 7)

Knowing for certain that all learners now had access to a laptop and the required resources meant that teachers could feel more confident monitoring and enforcing the need to complete homework. Teachers described how through access to the devices, they were now able to be more confident in knowing that the inability to complete homework was not a digital poverty

issue. For one teacher, this confidence also translated in to being able to discuss with parents why learners had not completed the required homework.

> *"It's just again knowing that kids have got access to a laptop and devices and something they need to access their own education. No excuses. Remember, some of the, you know, valid reasons why people don't do homework is because they don't have the resources at home. And sometimes you just make that assumption, that they all have laptops, which is not the case."* (Participant 3)

> *"Then there's no excuses, but [interviewer name], you know, we're dealing with pupils that obviously with teenagers some just don't wanna do any work and with us knowing that they have no excuse because they all have a laptop and the necessary software we, it's just much easier to follow things through with parents and you know expectations that we have in terms of the work from pupils."* (Participant 3)

In particular, one teacher described how they felt that parents became more supportive, as they were also confident in the knowledge that the learners could complete the work.

> *"Yeah, all I can really say on that note is that when I ask the parents, ohh, can you just make sure that you're monitoring that your child is doing XYZ, they've got more comfortable or supportive because they*

know that the device is there for them to get on with it." (Participant 4)

Many of the teachers also described that, following the Tech4Schools scheme, there was a positive impact on learning within school in addition to at home, improving both the ease and the quality of learning in class.

"The ability to provide students with a laptop so that they can use it in lessons for research, translation, etc has made their learning easier and has helped teachers as well." (Participant 5)

Reasons for this improvement included the lack of constraints of when and for how long the devices could be used for and the ability to use the devices to support learning through a range of activities both within IT and computer science subjects and also the wider curriculum. Together, this highlighted the breadth of possibilities for the Tech4Schools scheme.

"The scheme has allowed the children in my class to really benefit from some in depth lessons both in computing and other areas, mainly due to the fact there is no time constraint on when we can use the devices." (Participant 6)

"We have been able to incorporate the laptops into more lessons as they belong to the class […] so far we have been able to use the laptops during maths and English lessons, research in science,

geography and history and coding for music and computing."
(Participant 6)

Some of the teachers further described how this positive impact on lessons was reflected both in learners' motivation to learn, and their digital skills.

"The children in the class are more motivated when using the laptops. They look forward to lessons in which they are used, and are developing lots of computing skills." (Participant 6)

"They have been using technology with more confidence and have been bettering their IT skills along the way." (Participant 5)

Overall, the teachers believed that the learners that they worked with were very grateful and that "*they're very happy they have a laptop"* (Participant 2). One teacher talked about how, through receiving the laptop, they believed that their students felt valued and another described how the access to the laptops potentially reduced the anxiety that their learners experienced.

"Yeah, they are. Do you know what the gratitude was big. Like when [name] gave out the laptops, you could just see their faces. How they were, they were just so… they felt loved. Like it was sweet. It was nice." (Participant 4)

"They seem really happy, they are able to complete all homework and not have to worry about not having access to doing this." (Participant 8)

In addition to the benefits to the teachers and learners, the teachers also talked about how they believed that the parents of the learners who received a device also benefited from the Tech4Schools scheme. The teachers reported that they thought the scheme took some pressure off parents by freeing up family resources in a number of ways. Firstly, it allowed access to a device without placing a financial burden on struggling families which had been exacerbated by the current cost of living crisis in the UK.

"You know what? There's a lot of pressure taken off in terms of finance for parents. For some of the people that received the laptop, you know they will open up when I distribute them, and I identify the people that really need them and ask them why, they did give me reasons and a lot of reasons were to do with finance, poverty, not being able to afford to buy laptops. So I can imagine that pressure taken off parents. During this, you know, cost of living crisis that everyone's sort of going through right now. So the timing was perfect." (Participant 1).

"Given students an advantage to go further in school with the equipment they need, without putting pressure on struggling families." (Participant 8)

Secondly, one teacher described how access to the device freed up existing family resources, and in some cases reduced or eliminated the need to share devices between multiple household members.

> *"Parents also have had to share their own laptop with some of our pupils, so getting that laptop meant they have more accessibility and they have their own laptop."* (Participant 3)

Finally, one teacher noted that the access to a device afforded through the Tech4Schools scheme meant that learners no longer needed to stay after school to complete work that required digital resources. The teacher suggested that this was positive both for the learners and for parents who rely on their children to help with childcare for siblings.

> *"Before, they'd be like I well I don't really know what I can do, they'll have to just stay behind after school whereas now, it's just it's a bit more flexible, especially when some of them need to get home and look after their siblings so they can go home, you know, be in the same house where the siblings are and get their work done."* (Participant 4)

Limitations of the scheme

Although teachers reported many positives of the Tech4School scheme, they also highlighted some limitations and areas where the scheme could go further. In particular, some of the teachers identified a lack of reliable internet access as a persistent problem that was not

addressed fully by the Tech4Schools scheme. As such, some teachers recommended support with internet access, such as through providing Wi-Fi dongles.

> *"you know we can provide laptops, but some people would still struggle with connectivity at home. So maybe if Wi-Fi dongles or some kind of broadband connectivity could be provided, I think that would be an extra boost."* (Participant 2)

> *"It is important to make sure they have wi-fi access as well, as many will not."* (Participant 5)

> *"Yeah, but even some of them, even when they had phones, you've obviously got issues with broadband connectivity. Bundles and things as such. So yeah, it was a big challenge for some of our students."* (Participant 3)

One teacher described how in some cases, lacking internet access entirely was a repeated problem that was caused by insecure housing and regular moves.

> *"And another thing is that some of our pupil's that they live in housing accommodation provided by the Council and some of our pupils need to move around a lot. They are they are living in temporary accommodation but with that means sometimes they go weeks without having any Internet connection at home because if they have to change houses it means changing providers and as you*

know, these things can take time, it's not something that can be sorted overnight." (Participant 3)

Recognising the benefits of the Tech4Schools scheme, several of the teachers also recommended it simply be expanded and extended to more students who would otherwise miss out on digital inclusion.

"I think well for me there's probably more students who would benefit from that, but obviously I think numbers and costs will come into place in it. Yeah, I think a lot more kids would benefit from this scheme." (Participant 2)

However, while participant 2 recognised that they would like the scheme to be rolled out to all, they were also cognisant of the practicalities and the costs associated with such an extension of the scheme.

"Yeah, the limit, obviously you can't provide an endless supply, but it'll be beneficial as well, if the numbers were to be increased." (Participant 2)

Another participant also described how that because of the challenges associated with providing "*technology for every child in every school so there will always be someone who misses out on the opportunity."* (Participant 6)

Summary of teacher data

The thematic analysis of the teacher data resulted in three main themes: (a) Difficulties before the scheme, (b) benefits of the scheme, and (c) limitations of the scheme. In the difficulties before the scheme theme, the teachers recognised the lack of digital resources in the learning environment both at school and at home impacted on learners' opportunities to engage with learning opportunities especially in an environment that is becoming increasingly digital. This finding reflects tensions seen in previous research where teachers have described how the lack of digital resources can adversely impact on the type and quality of provision (Montacute & Cullinane, 2021). Aligned to this tension was the need for the devices that learners had access to be current and up to date suggesting that it was both access and age of the device that are important. The teachers also noted that device sharing amongst family members was common, which is something that was identified as a concern for many during the pandemic (Montacute & Cullinane, 2021). Related to the lack of access, the teachers also recognised that there was a potential embarrassment for not having access to the resources that were required for education.

Regarding the benefits of the Tech4Schools scheme the teachers suggested that the scheme facilitated access that enabled learners to complete homework that required a laptop. In addition to facilitating completion of homework tasks, when the required software was available on the devices it facilitated independent learning. Previous research suggests that technology can support personalised learning (Major et al., 2021). Teachers talked about how prior to the access afforded by the Tech4School scheme, they were unsure as to the reasons why learners had not completed the required tasks. Having confidence in understanding the reasons why learners have not engaged with learning opportunities is likely to reduce uncertainty for teachers and mitigate against the potential vulnerability associated with uncertainty (Twyford et al., 2017).

The teachers also suggested that the access to devices encouraged parents to be supportive of learning as they knew learners had the resources to complete the tasks. Previous research shows that positive home-school relationships between parents and teachers are particularly important for a successful learning (Comer, 1984), especially for families with limited financial resources (Pemberton & Miller, 2015). The teachers in the current evaluation also talked about how they thought the scheme benefited parents in various ways including providing access to resources without providing a financial burden on parents, reducing the need to share parent laptops, and freeing learners to support with childcare for siblings because they no longer had to stay after school to access devices. This is an important consideration given that many young people in the UK provide informal childcare for their siblings (Bryson et al., 2008). Finally, teachers also talked about how the positive impact of the devices extended to students' motivation to learn and their digital skills.

The teachers did identify several limitations with the scheme and possible strategies to mitigate against these limitations. For example, the challenges associated with connectivity could be overcome by providing Wi-Fi dongles. Such a provision of dongles would overcome some of the challenges that teachers recognised associated with insecure housing and the time taken to setup broadband. Previous research has identified insecure housing and a lack of suitable internet connections as particular challenge associated with digital poverty (Holmes & Burgess, 2022). The teachers also talked about widening the scheme to others so that all learners had the opportunity to benefit from the access to technology.

Case studies

From the different strands of data collection, four case studies[1] associated with the Tech4School Scheme were identified. Together, these case studies highlight the impact of the intervention.

Case study 1: Enhancing learners' digital skills and engagement

Through taking part in the Tech4Schools scheme learners reported higher levels of taking part at school. Also, those learners who had high use of the device in school showed increased digital self-efficacy.

Case study 2: Access to the device reduced strain on families

Teachers and parents talked about how the Tech4School scheme reduced device sharing. Through providing individual access to a device, the Tech4School scheme has reduced the need for learners to share devices with other family members and/or reduced the potential financial burden of families having to provide devices for learning. This means that learners can engage in their learning activities more easily and without having to put a strain on the family's resources.

Case study 3: Access to the device enabling learners to support their family

One teacher talked about how the Tech4Schools scheme had enabled learners to support their family. Through having access to a device, learners who used to have to stay behind after the school day to access digital technology in school in order to complete their work no

[1] Note we are using the term case study to represent the documentation of the story/experience of an individual, group, or school who have engaged with the intervention

longer need to. This means that learners can now return home as school finishes and provide support to their family through caring for their siblings.

Case Study 4: The impact of insecure housing

Some of the teachers suggested that for those learners who experience insecure housing, although access to the device supports learning opportunities, access on its own does not overcome the challenges associated with not having access to a reliable internet connection. Due to learners experiencing frequent relocations, it was suggested that they may not always have access to a reliable internet connection and that access to Wi-Fi dongles would mitigate this.

Discussion

Integration of findings across learners, parents, and teachers

Plano Clark's (2019) guidelines were followed for integration of findings across mixed method studies to extend understanding of the results beyond the individual participant level. Five key findings were identified which align with the Theory of Change for the Tech4Schools scheme (outlined in Figure 5, page 19).

1. Teachers and parents recognised that that there were several benefits of the Tech4School intervention.
2. Teachers highlighted how the Tech4School scheme positively impacted learners' motivation to learn and their digital skills. Relatedly, parents talked about how the Tech4School scheme enabled learners to engage with learning opportunities. The learner data suggested that high use of the device in school predicted an increase in their digital skills assessed as digital self-efficacy. There was also evidence that for learners that engagement with the scheme increased their reports of taking part (as an indicator of school engagement) with time. This finding complements the perspective

of teachers and parents that the Tech4School impacts on learners' ability to take part in the learning opportunities.

3. Both parents and teachers highlighted how the access to the device provided by the Tech4Schools scheme overcame challenges associated with device sharing. Parents and teachers commented that prior to the scheme family members shared a device and this impacted on learners' ability to engage with school activities. This finding is consistent with previous research that described how device sharing represents a challenge for online learning during the pandemic (Montacute & Cullinane, 2021) and for those experiencing digital poverty (Holmes & Burgess, 2022).
4. Aligned to the challenges of device sharing identified by teachers and parents, although not raised as an issue by parents, teachers talked about how the Tech4School scheme may reduce financial burdens on parents.
5. Teachers suggested that the Tech4School scheme should be widened to others but one of the parents did question the eligibility criteria for the scheme.

Limitations and implications for future evaluations

There are four main limitations associated with the evaluation. First, the evaluation only focused on those learners who received a device and, as such, it was not possible to make comparisons to learners with a similar profile who did not receive a device. Although it is important to acknowledge the underpinning ethical issues of some learners having the immediate opportunity to benefit from the intervention while others do not, future evaluations may want to consider the possibility of exploring a waiting list control design. Waiting list control designs typically have a group that are receiving the intervention and a group that will receive the intervention at a later date (Elliot & Brown, 2002). Comparisons are then made between groups on key variables before the second group receives the intervention.

Second, there was a reduction in number of learners participating in the evaluation over time. However, there was no evidence of systematic attrition and the multi-level modelling technique adopted in the study accounted for missing data. King and He (2006) also argue that typically only modest sample sizes are required to identify significant relationships in the TAM. Relatedly, the number of teachers and parents who participated was small meaning that the results must be interpreted with caution. However, experiencing challenges in trying to recruit parents through school settings is something that has been acknowledged is previous research (Schilpzand et al., 2015). Future evaluations could adopt techniques such as pre-notification postcards and recruitment process graphs which Schilpzand et al. suggested were effective but were beyond the scope of the current evaluation.

Finally, as with most studies that apply the TAM, the current study relied on self-reports of technology rather than objectively measuring actual device use (see Lee et al., 2003). This approach potentially means that there could be variation in the reported use and the actual use and that the findings may reflect variance in self-reported use (Legris et al., 2003). However, the response scale we used to measure device use has been found to be comparable to objective digital trace date for smartphone use (Marciano & Camerini, 2022). Moreover, as well as exploring time spent using the device, we also explored how the device was used. Future evaluations could consider adopting a more objective measure of device use through logs on the device.

Conclusions

In conclusion, there was clear evidence of the benefit of the Tech4School intervention and this was something that was identified by learners, teachers, and parents. Drawing across the findings from these multiple informants, there is evidence that the Tech4School scheme positively impacted learners' motivation to learn and their digital skills. Further, high use of

devices in school predicted increases in the learners' digital skills and promoted elements of their school engagement over time providing further evidence that the Tech4School scheme positively impacts on learners' ability to engage with learning opportunities.

References

Al-Azawei, A., Parslow, P., & Lundqvist, K. (2017). Investigating the effect of learning styles in a blended e-learning system: An extension of the technology acceptance model (TAM). *Australasian Journal of Educational Technology*, *33*(2).

Aburezeq, I. M., Ishtaiwa-Dweikat, F. F., & Patronis, M. (2020). Behavioral intention to use mobile technology in language teaching: A qualitative analysis of a UAE case study. *International Journal of Technology and Human Interaction, 16*(4), 14–34.

Aldekheel, A. Y., Khalil, O., & AlQenaei, Z. M. (2022). Factors impacting teachers' continued IT adoption in pre-college education. *Journal of Information Technology Education Research, 21,* 465–500.

Allison, P. D. (2000). Multiple imputation for missing data: A cautionary tale. *Sociological Methods & Research*, *28*(3), 301-309.

Allman, K. (2022). UK digital poverty evidence review 2022. https://digitalpovertyalliance.org/wp-content/uploads/2022/06/UK-Digital-Poverty-Evidence-Review-2022-v1.0-compressed.pdf

AlQenaei, Z. M., Khalil, O., & Aldekheel, A. Y. (2021). Integrating information technology in precollege education in Kuwait: Teachers' perspectives on a botched initiative. *Journal of Information Technology Education, Research, 20,* 529-558.

Anderson, E. (2022). Amazon and the Learning Foundation launch new scheme to provide disadvantaged schools with devices and digital support. Retried from https://learningfoundation.org.uk/amazon-learning-foundation-scheme-provide-disadvantaged-schools-devices-digital-support/ Accessed 15/08/23

Andrew, A., Cattan, S., Costa-Dias, M., Farquharson, C., Kraftman, S., Krutikova, S., … Sevilla, A. (2020). *Learning during the lockdown: Real-time data on children's experiences during home learning*. The Institute for Fiscal Studies.

Arndt, E., & Peterson, D. (2018). Experience alters perceptions of educational technology acceptance among adolescents. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 62, No. 1, pp. 1088-1092). Sage CA: Los Angeles, CA: SAGE Publications.

Atwood-Blaine, D., Rule, A. C., & Walker, J. (2019). Creative self-efficacy of children aged 9-14 in a science center using a situated Mobile game. *Thinking Skills and Creativity*, *33*, 100580.

Bates, D., Maechler, M., Bolker, B., & Walker, S. (2015). Fitting Linear Mixed-Effects Models Using lme4. *Journal of Statistical Software*, *67*(1), 1-48.

Bergdahl, N., Nouri, J., Fors, U., & Knutsson, O. (2020). Engagement, disengagement and performance when learning with technologies in upper secondary school. *Computers & Education*, *149*, 103783.

Blunch, N. J. (2012). *Introduction to structural equation modeling using IBM SPSS Statistics and AMOS*. London: Sage.

Bonanati, S., & Buhl, H. M. (2022). The digital home learning environment and its relation to children's ICT self-efficacy. *Learning Environments Research*, *25*(2), 485-505.

Braun, V., Clarke, V., Hayfield, N., & Terry, G. (2019). Thematic analysis. In P. Liamputtong (Ed.), *Handbook of research methods in health social sciences* (pp. 843–860). Singapore: Springer.

British Academy (2022), Understanding digital poverty and inequality in the UK, The British Academy, London

Bryson, C., Brewer, M., Sibieta, L., & Butt, S. (2008). The role of informal childcare: A synthesis and critical review of the evidence. Available at https://www.nuffieldfoundation.org/sites/default/files/files/The_role_of_informal_childcare_FULL_REPORT.pdf Retrieved 25/09/23

Byrne, B. M. (2010). *Structural equation modeling with AMOS: Basic concepts, applications, and programming* (2nd ed.). New York: Routledge.

Cacciamani, S., Villani, D., Bonanomi, A., Carissoli, C., Olivari, M. G., Morganti, L., ... & Confalonieri, E. (2018). Factors affecting students' acceptance of tablet PCs: A study in Italian high schools. *Journal of Research on Technology in Education, 50*(2), 120-133.

Cheema, J. R. (2014). Some general guidelines for choosing missing data handling methods in educational research. *Journal of Modern Applied Statistical Methods*, *13*(2), 3.

Child, D. (1990). *The essentials of factor analysis* (2nd ed.). London: Cassel Education Limited.

Cohen, J. W. (1998). *Statistical power analysis for the behavioral sciences* (2nd ed). Hillside, NJ: Lawerence Erlbaum Associates.

Coleman, V. (2021). Digital divide in UK education during COVID-19 pandemic: Literature review. Cambridge Assessment Research Report. Cambridge, UK: Cambridge Assessment.

Comer, J. P. (1984). Home-school relationships as they affect the academic success of children. *Education and Urban Society*, *16*(3), 323-337.

Cuhadar, C. (2014). Information technologies pre-service teachers' acceptance of tablet PCs as an innovative learning tool. *Kuram Ve Uygulamada Egitim Bilimleri*, *14*(2), 741–753.

Çukurbaşı, B., İşbulan, O., & Kıyıcı, M. (2016). Acceptance of educational use of tablet computers: A critical view of the FATIH Project. *Education & Science/Egitim ve Bilim, 41*(188).

Dafoulas, G. D., Ueno, A., & Dennis, C. (2022). Digital poverty in the UK: Analysis of secondary data. https://www.thebritishacademy.ac.uk/documents/4357/Digital_Poverty_in_the_UK_Analysis_of_Secondary_Data.pdf

Davis, F. D. (1986). A technology acceptance model for empirically testing new-end user information systems: Theory and results. Doctoral dissertation, MIT Sloan School of Management, Cambridge, MA, USA.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319-340.

Diseko, R., Nyamande, T. T., & Kuhudzai, A. G. (2022). Factors affecting teacher acceptance of tablets in their teaching practice: A case study in the South African context. *International Journal of Mobile and Blended learning, 14*(1). https://doi.org/10.4018/IJMBL.297975

Elena-Bucea, A., Cruz-Jesus, F., Oliveira, T., & Simões Coelho, P. (2021). Assessing the role of age, education, gender and income on the digital divide: Evidence from the European Union. *Information Systems Frontiers, 23,* 1007-1021.

Elliott, S. A., & Brown, J. S. L. (2002). What are we doing to waiting list controls?. *Behaviour Research and Therapy*, *40*(9), 1047-1052.

Elyazgi, M. G., Nazâ, M., Rahim, N. Z. A., & Imtiaz, M. A. (2014). Feasibility study of tablet pc acceptance among school children in Malaysia. *Journal Teknologi, 69*(2).

Ewing, L. A., & Cooper, H. B. (2021). Technology-enabled remote learning during COVID-19: Perspectives of Australian teachers, students and parents. *Technology, Pedagogy and Education*, *30*(1), 41-57.

Faith, B., & Beecher, J. (2022). Digital Poverty in the UK. https://www.thebritishacademy.ac.uk/documents/4355/Digital_Poverty_in_the_UK.pdf

Fredricks, J. A., Blumenfeld, P., Friedel, J., & Paris, A. (2005). School Engagement. In K. A. Moore & L. H. Lippman (Eds.), *What do children need to flourish: Conceptualizing and measuring indicators of positive development* (pp. 305–321). Springer

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of Educational Research*, *74*(1), 59-109.

Haleem, A., Javaid, M., Qadri, M. A., & Suman, R. (2022). Understanding the role of digital technologies in education: A review. *Sustainable Operations and Computers*, *3*, 275-285.

Hammer, M., Scheiter, K., & Stürmer, K. (2021). New technology, new role of parents: How parents' beliefs and behavior affect students' digital media self-efficacy. *Computers in Human Behavior*, *116*, 106642.

Holmes, H., & Burgess, G. (2022). Digital exclusion and poverty in the UK: How structural inequality shapes experiences of getting online. *Digital Geography and Society*, *3*, 100041.

Gorhan, M. F., Oncu, S., & Senturk, A. (2014). Tablets in education: Outcome expectancy and anxiety of middle school students. *Educational Sciences: Theory and Practice, 14*(6), 2259-2271.

Grapentine, T. (2000). Path analysis vs. structural equation modeling. *Marketing research*, *12*(3), 13-20.

Granić, A., & Marangunić, N. (2019). Technology acceptance model in educational context: A systematic review of the literature. *British Journal of Educational Technology, 50*(5), 2572-2593.

Harju, V., Koskinen, A., & Pehkonen, L. (2019). An exploration of longitudinal studies of digital learning. *Educational Research*, *61*(4), 388-407.

Hietajärvi, L., Maksniemi, E., & Salmela-Aro, K. (2022). Digital engagement and academic functioning. *European Psychologist, 27*(2), 102-115.

Holden, R. J., & Karsh, B-T. (2010). The technology acceptance model: Its past and its future in health care. *Journal of Biomedical Informatics, 43,* 159-172.

Hougham, R. J., Nutter, M., & Graham, C. (2018). Bridging natural and digital domains: Attitudes, confidence, and interest in using technology to learn outdoors. *Journal of Experiential Education*, *41*(2), 154-169.

Hsiao, K. L., & Chen, C. C. (2015). How do we inspire children to learn with e-readers?. *Library Hi Tech. 33*(4), 584-596.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(1), 1-55.

Ifenthaler, D., & Schweinbenz, V. (2016). Students' acceptance of tablet PCs in the classroom. *Journal of Research on Technology in Education, 48*(4), 306-321.

Jackson, L. A., von Eye, A., Fitzgerald, H. E., Zhao, Y., & Witt, E. A. (2010). Self-concept, self-esteem, gender, race and information technology use. *Computers in Human Behavior*, *26*(3), 323-328.

Jimerson, S. R., Campos, E., & Greif, J. L. (2003). Toward an understanding of definitions and measures of school engagement and related terms. *The California School Psychologist*, *8*, 7-27.

Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing*, *72*(12), 2954-2965.

Kay, R., & Lauricella, S. (2016). Assessing laptop use in higher education: The Laptop Use Scale. *Journal of Computing in Higher Education*, *28*, 18-44.

Kenward, M. G., & Roger, J. H. (1997). Small sample inference for fixed effects from restricted maximum likelihood. *Biometrics*, 983-997.

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management, 43,* 740-755.

Kline, P. (1993). *The handbook of psychological testing.* New York; Routledge

Lee, Y., Kozar, K. A., & Larsen, K. R. T. (2003). The technology acceptance model: Past, present, and future. *Communications of the Association for Information Systems, 12,* 752-780.

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management 40,* 193-204.

Lehrl, S., Evangelou, M., & Sammons, P. (2020). The home learning environment and its role in shaping children's educational development. *School Effectiveness and School Improvement*, *31*(1), 1-6.

Lin, C. C. (2014). Learning English reading in a mobile-assisted extensive reading program. *Computers & Education, 78,* 48-59.

Lo, S. L., & Miller, A. L. (2020). Learning behaviors and school engagement: opportunities and challenges with technology in the classroom. *Technology and Adolescent Health*, 79-113.

Lucas, P. J., Robinson, R., & Treacy, L. (2020). What is data poverty? https://apo.org.au/sites/default/files/resource-files/2020-12/apo-nid310124.pdf

Lüdecke, D. (2021). sjPlot: data visualization for statistics in social science. R package version 2.8. 10. *R Foundation for Statistical Computing*. https://CRAN.R-project.org/package=sjPlot

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, *1*(2), 130-149.

Mädamürk, K., Tuominen, H., Hietajärvi, L., & Salmela-Aro, K. (2021). Adolescent students' digital engagement and achievement goal orientation profiles. *Computers & Education*, *161*, 104058.

Major, L., Francis, G. A., & Tsapali, M. (2021). The effectiveness of technology-supported personalised learning in low-and middle-income countries: A meta-analysis. *British Journal of Educational Technology*, *52*(5), 1935-1964.

Marangunić, N., & Granić, A. (2015). Technology acceptance model: A literature review from 1986 to 2013. *Universal Access in the Information Society, 14,* 81-95.

Marciano, L., & Camerini, A. L. (2022). Duration, frequency, and time distortion: Which is the best predictor of problematic smartphone use in adolescents? A trace data study. *PLOS One*, *17*(2), e0263815.

Michie, S., Johnston, M., Francis, J., Hardeman, W., & Eccles, M. (2008). From theory to intervention: mapping theoretically derived behavioural determinants to behaviour change techniques. *Applied Psychology*, *57*(4), 660-680.

Montacute, R., & Cullinane, C. (2021). *Learning in lockdown: Research brief*. The Sutton Trust. https://www.suttontrust.com/wp-content/uploads/2021/01/Learning-in-Lockdown.pdf

Moses, P., Wong, S. L., Abu Bakar, K., & Mahmud, R. (2013). Perceived usefulness and perceived ease of use: Antecedents of attitude towards laptop use among science and mathematics teachers in Malaysia. *Asia-Pacific Education Researcher, 22*(3), 293–299.

Netemeyer, R. G., Bearden, W. O., & Sharma, S. (2003). *Scaling procedures: Issues and applications*. sage publications.

Pemberton, K. D., & Miller, S. (2015). Building home–school relationships to enhance reading achievement for students from families with limited financial resources. *Education and Urban Society*, *47*(7), 743-765.

Perry, D. R., & Steck, A. K. (2015). Increasing student engagement, self-efficacy, and meta-cognitive self-regulation in the high school geometry classroom: Do iPads help?. *Computers in the Schools*, *32*(2), 122-143.

Plano Clark, V. L. (2019). Meaningful integration within mixed methods studies: Identifying why, what, when and how. *Contemporary Educational Psychology, 57* 106-111.

Prior, D. D., Mazanov, J., Meacheam, D., Heaslip, G., & Hanson, J. (2016). Attitude, digital literacy and self-efficacy: Flow-on effects for online learning behavior. *The Internet and Higher Education*, *29*, 91-97.

Rahali, E. A., Khattabi, K. E., Chikhaoui, A., & Ouzennou, F. (2022). Towards a model of situated acceptance of tablets in teaching practice in Moroccan primary schools. *International Journal of Interactive Mobile Technologies, 16*(14), 182-200.

Revelle, W. (2022) psych: Procedures for Personality and Psychological Research, Northwestern University, Evanston, Illinois, USA, https://CRAN.R-project.org/package=psych Version = 2.2.3

Rizk, J., & Davies, S. (2021). Can digital technology bridge the classroom engagement gap? Findings from a qualitative study of k-8 classrooms in 10 ontario school boards. *Social Sciences*, *10*(1), 12. https://doi.org/10.3390/socsci10010012

Yves Rosseel (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software, 48*(2), 1-36. https://doi.org/10.18637/jss.v048.i02

Sahadani, N., & Salleh, S. (2014). Investigating Students' Acceptance Of Tablet PC In Learning Science: An Application Of The Modified Technology Acceptance Model. *EDULEARN14 Proceedings*, 3203-3215.

Schilpzand, E. J., Sciberras, E., Efron, D., Anderson, V., & Nicholson, J. M. (2015). Improving survey response rates from parents in school-based research using a multi-level approach. *PloS one*, *10*(5), e0126950.

Scherer, R., Siddiq, F., & Tondeur, J. (2019). The technology acceptance model (TAM): A meta-analytic structural equation modelling approach to explaining teachers' adoption of digital technology in education. *Computers & Education, 128,* 13-35.

Schoonenboom, J., & Johnson, R. B. (2017). How to construct a mixed methods research design. *KZfSS Kölner Zeitschrift für Soziologie und Sozialpsychologie*, *69*(2), 107-131.

Selwyn, N. (2016). Digital downsides: Exploring university students' negative engagements with digital technology. *Teaching in Higher Education*, *21*(8), 1006-1021.

Sheeran, P., & Webb, T. L. (2016). The intention–behavior gap. *Social and Personality Psychology Compass*, *10*(9), 503-518.

Shukla, A., & Sharma, S. K. (2018). Evaluating consumers' adoption of mobile technology for grocery shopping: an application of technology acceptance model. *Vision*, *22*(2), 185-198.

Spera, C., Wentzel, K. R., & Matto, H. C. (2009). Parental aspirations for their children's educational attainment: Relations to ethnicity, parental education, children's academic performance, and parental perceptions of school climate. *Journal of Youth and Adolescence*, *38*, 1140-1152.

Talaee, E., & Noroozi, O. (2019). Re-conceptualization of the "Digital Divide" among primary school children in an era of saturated access to technology. *International Electronic Journal of Elementary Education, 12*(1), 27-35.

Twyford, K., Le Fevre, D., & Timperley, H. (2017). The influence of risk and uncertainty on teachers' responses to professional learning and development. *Journal of Professional Capital and Community*, *2*(2), 86-100.

Ulfert-Blank, A. S., & Schmidt, I. (2022). Assessing digital self-efficacy: Review and scale development. *Computers & Education*, 104626.

Underwood, J., Baguley, T., Banyard, P., Dillon, G., Farrington-Flint, L., Hayes, M., ... & Selwood, I. (2010). Understanding the impact of technology: Learner and school level factors.

van Dijk, J. A. (2017). Digital divide: Impact of access. In P Rőssler, C. A. Hoffner, & van Zoonen (Eds.), *The international encyclopedia of media effects*, (1-11). Wiley Online Library, John Wiley & Sons.

van Dijk, J. (2020). *Closing the digital divide: The role of digital technologies on social development, well-being of all and the approach of the Covid-19 pandemic*. https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/07/Closing-the-Digital-Divide-by-Jan-A.G.M-van-Dijk-.pdf

Ventouris, A., Panourgia, C., & Hodge, S. (2021). Teachers' perceptions of the impact of technology on children and young people's emotions and behaviours. *International Journal of Educational Research Open*, *2*, 100081.

Weiss, C. H. (1995). Nothing as practical as good theory: Exploring theory-based evaluation for comprehensive community initiatives for children and families. In J. Connell, A. Kubisch, L. Schorr & C. Weiss (Eds.), *New approaches to evaluating comprehensive community initiatives* (pp. 65-92). New York: The Aspen Roundtable Institute.

Wonglorsaichon, B., Wongwanich, S., & Wiratchai, N. (2014). The influence of students school engagement on learning achievement: A structural equation modeling analysis. *Procedia-Social and Behavioral Sciences*, *116*, 1748-1755.

Zheng, J., & Li, S. (2020). What drives students' intention to use tablet computers: An extended technology acceptance model. *International Journal of Educational Research, 102,* 101612.