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Equitable digital access to the Internet beyond school: A literature review

Report commissioned by the
Ministry of Education
Te Tāhuhu o te Mātauranga

Louise Starkey, Elizabeth Eppel, Allan Sylvester, Rana Daoud and Tho Vo

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Executive summary

Policy interventions that have provided Internet access to the home of school aged children have been made with the intention of closing digital divides within or between communities. The interventions identified have provided access to the Internet and digital devices in the child's home with the aim of developing children's digital capabilities, motivation to learn, academic achievement, parental engagement in their child's education, and/or to enable student-centred pedagogies. While not all initiatives have evaluations available, the ones that were have mixed results. Digital inclusion has four aspects: access, motivation, capability and trust. The interventions identified in this review focused on developing access and capability, which align with early notions of digital divides. Developing participatory digital citizenship for those on the wrong side of the divide has yet to be identified as a focus in policy interventions.

Through the process of identifying and analysing research literature, a lag in available evidence was identified. Between approximately 2000 and 2015 policy initiatives aimed at bridging digital divides primarily focused on providing access to hardware, or digital devices such as desk-top computers or laptops, with some also including access to the Internet beyond school buildings. More recent initiatives, which focus on Wi-Fi or Mobile access, are not yet widely published. Further constraining factors on the availability of publications associated with Internet initiatives is the lack of publications when particular initiatives are withdrawn or the results are considered not noteworthy because of perceived lack of impact.

Studies that specifically measured the educational value of home Internet access were located and analysed. Through this process three areas of educational value were identified; the learning, psychological and social domains. The studies that measured learning included 68 studies that reported a positive learning outcome, six reported a negative outcome (half of these were in the area of literacy) and four reported neutral outcomes. In the psychological domain, 22 studies reported positive outcomes from home Internet access, three reported negative and three were neutral. In the social domain 13 were positive and one was negative. It can therefore be concluded that home Internet access has a positive impact on student learning, psychological development and social aspects, but not always. The conditions that influence the educational value include aspects in the home context and the home-school alignment.

In the home context, a recurring theme is that children are using the Internet for different purposes. Children's Internet use at home is influenced by different factors including gender, age, cultural context and socio-economic status of their families. Children of parents with low education levels, few technical skills, and in low socio-economic households tend to have less positive outcomes or Internet use at home compared to their peers with greater cultural capital. This suggests that providing the Internet into the home will not close a digital divide without interventions that counteract the contextual disadvantage such as providing access to technical and academic support for the students (which may be through the parents for younger children). However, it should be noted that children in low socio-economic communities have been found to develop a strong sense of autonomy and agency which may be attributed to the home context where they may be experts in the academic and technical expectations of learning at home through the Internet. Thus teachers have a pivotal role in maximising the educational value of home Internet access in low socio-economic contexts through the setting of cognitively demanding autonomous learning activities.

Internet access offers children a range of activities for entertainment such as playing games, watching movies or listening to music and ways to communicate and collaborate with others through social media and communication technology. How this is used varies according to the age of the child and gender and parental mediation. Children who are gaming during the week have been found to do less well academically and children who spend little time on the Internet are also disadvantaged through a lack of digital literacy, therefore parental mediation of use is important. Parents adopt different styles with varying mediation strategies that influence children's learning opportunities and online risk. The style adopted is influenced

by the cultural context of the family. An authoritative style and co-using strategies has a positive effect on children's learning through the Internet at home and a laissez-fair style can reduce children's risky behaviours online.

Children use the Internet for different forms of learning at home. The Internet is most commonly used for accessing, presenting information, communicating, and skill development through gaming activities. Although the educational value of these online activities have not been clearly identified, there is a risk that students in low socio-economic communities are given less cognitively challenging activities than their more wealthy peers, which further widens an educational value gap. A further gap that may exist is one of participation, a digital divide between groups who influence decisions or opinions in society and those who do not. There was little evidence of research exploring students' participation in social, economic or political digital contexts to empower their position in society and reduce future digital divides. However, it may be that this type of research was not associated with home Internet access and instead is taught within schools, therefore not identified through this review.

Conclusion

Internationally, policy interventions to date have focused on the provision of devices and home Internet access as a means of addressing digital divides for children in low socioeconomic communities. These interventions have also often gone hand-in-hand with a focus on integration of digital tools into teaching practice and/or support for parents to moderate their children's Internet use appropriately to encourage use and skill development. Evidence of learning gains attributable to particular policy interventions are less frequently encountered. Where there is evidence, it seems to point to skills, attitudinal and motivational gains rather than increases in test scores in academic learning domains.

This literature review identified research that directly explored the educational value of home Internet access. Internet access in the home is related to positive outcomes for children's learning, psychological development, social skills and parental engagement in their child's education. However, the potential educational outcomes cannot be separated from the context in which learning occurs. Children's use of the Internet, parental style, family socio-economic context, and the alignment between home and school are each related to the educational value of home Internet access.

Recommendations.

The following recommendations are designed to provide the conditions identified in the research literature which are likely to maximise the educational value of home Internet access for students in low socio-economic communities that were:

1. Children in low socio-economic communities have access to the Internet at home and a digital device for learning
2. Teachers are supported to use the affordances of the Internet for educational purposes, including providing appropriate cognitively challenging online learning activities, developing children's digital competencies for learning and autonomy
3. Children's formal learning at home is aligned with their learning at school
4. Parents receive advice and guidance on how they can support their children's online activities to maximise the educational value of the Internet at home. Such advice should be sensitive and appropriate to cultural context and include information about parental mediation research and child safety online
5. Children have access to technical and academic support for learning at home
6. Further research and analysis be undertaken to evaluate online learning activities at home to identify high impact uses that maximise cognitive, social, psychological, and participatory benefits of home Internet use. The findings to be shared with teachers to inform practice.

Contents

Executive summary	3
Contents	5
Introduction	7
Methodology	9
Analysis process.	9
Findings	11
Home Internet provision policy initiatives	11
UK Home access programme	12
Early US initiatives.....	12
One laptop per child	13
ConnectED.....	13
Innovative schools digital promise.....	14
European initiatives	14
New Zealand local or regional initiatives	15
Other initiatives	16
Impact of home Internet access on educational outcomes	17
How is educational value measured?	17
The educational value of home Internet access	18
The learning domain	18
Formal learning.....	21
Informal learning.....	22
The psychological domain.....	22
The social domain	23
The conditions or factors that influence educational value	24
Factors related to children.....	24
Factors related to the family context	25
Factors related to school	25
The Home Context	26
Children’s home Internet use for general purposes	26
Entertainment.....	26
Communication.....	27
Collaboration	27
Education	27

Children’s use of the Internet for learning at home.....	27
Children’s use of the Internet for learning at home.....	30
Parents’ perception of children’s Internet use at home.....	33
Factors that influence children’s Internet use.....	34
Parental involvement.....	34
Parenting styles and dimensions.....	35
Parental mediation.....	37
The impact of parental involvement on children’s learning.....	39
Cultural context.....	41
Influence of cultural context on children’s use.....	41
Contextual variation in parenting styles and mediation.....	42
The home context and educational value.....	43
Home and school.....	43
The Internet as the substrate technology.....	43
Technology for supporting school (formal) learning at home.....	44
Application technologies.....	45
Technological synergy.....	46
Technological impacts.....	46
Summary.....	48
Conclusion.....	50
Recommendations.....	50
References.....	51
Appendices.....	59
Appendix 1. Summary of reviewed literature.....	59
Appendix 2: Interventions.....	92
Appendix 3. Analysis of Educational Value.....	102

Introduction

The Internet was introduced to New Zealand in the 1980s with an international connection established in 1989. Schools and homes started connecting to the Internet in the 1990s at a time when a connection was expensive, slow and with limited educational resources and functionality for teaching and learning. More recently, the New Zealand government instigated a national [Ultra-Fast Broadband Initiative](#) which by 2017 had provided Ultrafast or Rural Broadband to more than 1000 schools and when completed in 2022, 87% of New Zealanders will live in locations where fibre broadband is accessible. During this time mobile devices have improved in functionality and affordability and the growth of digital tools for learning has broadened beyond sending and receiving email and accessing information from the Internet. The schooling sector now is connected to high speed Internet and has access to flexible learning management systems, a range of online educational resources and communication tools that enable collaboration between students, and home and school. The Internet is a substrate technology accessed through digital devices.

Learning is not confined within the boundaries of school buildings and playing fields. Children and young people continue to learn beyond the school environment in a range of contexts including online. The nature of this learning is diverse and includes informal learning [1], independent study using curriculum materials, continuing activities started at school [2] or through individualised or group homework activities set by teachers [3]. Like the learning that occurs at school, learning beyond school increasingly makes use of Internet connected digital devices to explore online, access information or study programmes, develop and present ideas and to collaborate.

The effect that homework has on educational achievement, when examined in the pre-digital era, was found to have mixed results reflecting the complexity of interaction between the intended learning and differing contexts. A stronger correlation between homework and achievement has been identified for secondary students than younger students [4].

However, the resources, knowledge, cultural values and experiences of the family (the cultural capital) available in the home can influence the learning that occurs through homework. A Dutch study found that when homework was given to all students the achievement of students from low socio-economic/migrant households fell further behind that of peers from higher socio-economic families [5]. The primary school students in the study from low socio-economic/migrant households were found to receive less help with homework from their families. While research suggests that homework is less likely to significantly benefit students from low socio-economic households compared to their resource rich counterparts, this may not be the case in a digital age when an Internet connection can enable access to collaboration and resources beyond the home environment. The conditions under which educational value of having Internet access in the home is influenced by the home and school context is analysed within this review.

Where students have limited or constrained access to the Internet or digital devices beyond the schooling environment they may be at an academic disadvantage when compared with peers with access. They may not develop digital competencies and therefore not be active participants in future digital ecosystems. Three types of disadvantage can occur; a lack of access can create a first order digital divide, a second order digital divide is created between those who develop competence in the use of digital technologies and those less competent, and a third order digital divide is a participation divide between those who use digital tools to influence society or better themselves educationally, socially or economically and those who don't [6]. This third order divide may develop through what is learnt or experienced through schooling. People need to have the four components of digital inclusion

(access, capabilities, motivation and trust) to actively participate in the digital context. The extent of the advantage or disadvantage for school student's participation and learning through the availability of the Internet in the home, or beyond school, is explored in this review.

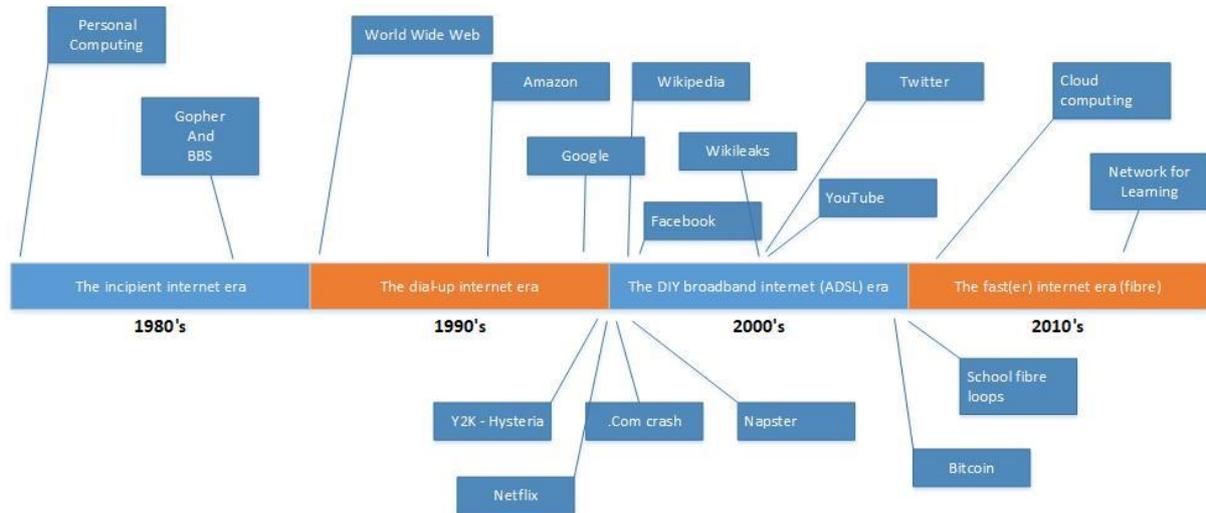


Figure 1. Internet timeline in New Zealand context – the journey so far: a brief snapshot

Methodology

The aim of this study was to analyse the evidence to answer the following research questions:

1. What is the educational value of home internet access?
2. How can the educational value of home Internet access be maximised?

The first stage of the analysis was to locate relevant peer reviewed research articles, theses and reports. This was carried out in three ways; a search of education publication databases, targeted search of specific sources, and following leads emerging from the research literature or researchers in the field.

Three journal aggregation databases were searched. These included EBSCO- education sources, Proquest (ERIC) and A+ education (Australasian specific). The databases were searched by applying keywords of Internet, home and learn*, achievement, school or education in the abstract of journal articles. This was found to yield the most relevant articles. In addition, the search limited publications to 2008 to 2018. This decision was made as the Internet speed, the technology and the available educational applications are changing over time and earlier studies may be too contextually different to the current day. Each of the titles and abstracts from the initial search were read which enabled the researchers to further filter for relevance. Resulting in 134 articles being identified for inclusion for analysis. Through this process three earlier articles were eliminated due to contextual time difference. For example, studies that were published ten years after the research was conducted.

The second search strategy was to target specific sources that may not be included in the aggregation databases or were specific to this topic. This included national and International theses, OECD library, Taylor-Francis online, SpringerLink, and Pew Internet and American Life publications. In addition, New Zealand specific sources were explored including NZCER, Ministry of Education reports and the 20/20 Communications Trust publications. Specific high-quality journals which publish in this area were manually searched through reading of titles and abstracts of all articles published since 2010. This included Computers and Education, Computers and Human Behaviour, Behaviour and Information Technology, British Journal of Educational Technology, Technology, Pedagogy and Education, and Learning Media and Technology.

The third search strategy was a 'snowball' technique. Where possible leads to relevant articles are identified from the literature or through talking with other researchers in the field. This included identifying authors researching in the area and home Internet initiatives that had been undertaken.

As a result of the literature search, 138 sources were identified and used in the analysis. Each was summarised in a table to provide a brief overview of research in the field (Appendix 1).

Analysis process.

Four areas of interest informed the analysis of the research literature.

In our first analysis of the literature we identified specific interventions which had as one of their aims or results giving children home Internet access. These were analysed to identify their design logic, implementation, context and time factors which influence their outcomes, other interventions running at the same time which might have contributed to the outcomes and finally how these interventions co-evolved with their implementation environments to produce unplanned for effects. The outcomes from these interventions were captured in the specific themed analysis that follows. In most of the literature there is no evidence of any specific intervention other than the existence of the Internet in home having occurred.

The second analysis sought to identify the educational value of home Internet access for school aged children. All articles that explored this question were analysed thematically to ascertain how educational value was explored in the research literature, what types of educational value was measured and the impact of home Internet access has on educational outcomes.

The third thematic analysis examined the home context. How children are using the Internet at home, parenting styles, cultural context, and how each of these influences the educational value of the Internet in the home.

The fourth analysis explored how the interactions or alignment between home and school might influence the educational value of the Internet in the home. This included the complementary and enabling mediating roles of the school and the parent/whānau and the teacher/school.

Findings.

The findings of the literature review are organised into themes derived from the research questions. The first section explores policy initiatives around the world to provide context and to consider the outcomes of such initiatives. The second section reports on research that specifically considers educational value, this includes how educational value has been measured and the impact that the introduction of home Internet access has had on the educational outcomes for children. The third section considers the home context, how children use the Internet at home, what type of learning activities they undertake and parental mediation to consider how the educational value of home Internet access can be maximised. The final section in the findings explores the alignment between home and school to maximise the educational value.

Home Internet provision policy initiatives

In this section we discuss the deliberate policies or interventions encountered through our literature review and through directed searching on the websites of some selected jurisdictions. Our selection is based on specific interventions or policies¹ mentioned in the literature reviewed or follow-up investigation of non-specific inferences to interventions mentioned along the way. Appendix 2 describes a range of interventions in different jurisdictions.

Policies and interventions are usually designed on the basis of an assumed or known theory of change. The designer of the intervention might have been a government, a department, an NGO or other community-based philanthropic organisation, and sometimes a combination of these. In the case of interventions that have acted on children's home Internet access and use, this specific intent might not have been explicit in the design of the intervention. We have included in this discussion any interventions we encountered which appear to have had an effect on children's opportunity and willingness to use the Internet at home in ways that might contribute educational value.

The general form of a theory of change is that by providing something as an input, the intervention changes the opportunities and disposition of the child's home Internet access, with an assumption of some outcome performance change as a result. The changes we specifically looked for were evidence aligned with digital inclusion, capabilities, the development of access, motivation and trust towards using the Internet beyond school in ways that contribute to children's learning and educational outcomes.

We also paid attention to contextual matters such as the socio-economic circumstances of the home, role of parents, the relationships between school and home, or teachers and home, and any other infrastructure with contributing effects on the outcomes observed. The decade-long scope of the literature review covers a period from when public use of fast Internet was beginning. In the older research, Internet use at home is less ubiquitous and the cost of devices and data plans was a barrier for both schools and homes. Thus, we see many of the early interventions were focused on overcoming the inequities of device access and ownership.

¹ Policies can take a number of forms: they might be named as a 'policy', they might also be known as an intervention, a programme, a scheme, a service or a piece of legislation as just a few examples considered here under this catch all name.

UK Home access programme

A typical developed-country policy initiative in the early era was the UK's *Home Access Programme* (HAP) which ran from 2008-2010 [7]. £300 million was allocated to subsidise the provision of computers and Internet access at home for low income families with learners. The programme was based on the intervention logic that 'promoting the value of home access and subsidising solutions for low income families would reduce the digital divide, thereby addressing a social inequity, and helping to raise the quality of education for all' (see [7], p.10).

The expected outcomes were 'enhanced use of home access for education, improved ICT skills and confidence, improved learner motivation and behaviour, enhanced opportunities for personalised learning, more parental engagement with children's education, enhanced attitudes and perceptions towards ICT. The national roll-out of the programme was targeted at pupils eligible for free school meals aged 7-14 years. In fact, only £198 million of the total fund was used before the programme was discontinued under the financial constraints created by the Global Financial Crisis and the different priorities of a new government.

A mixed-methods formative and summative evaluation of HAP found that the original assumption for the intervention was misplaced in that, over the duration of the intervention, Internet access and computers in homes rose rapidly. They concluded that, despite this, 'a sound case for intervention remained, given the acceleration of educational benefits, and given the cost barriers that still exist for the lowest income groups, provided that a) it was focused on benefiting those that previously did not have a computer and/or connectivity at home, and b) it was tightly coupled to initiatives to realise the pedagogical and parental engagement benefits of universal home access for learners [7].

The evaluators concluded that there were improved outcomes in terms of enhanced use of home access for education (learners on average using a computer at home for 10.1 hours per week, of which 4.7 hours were on learning-related activities). Participating children said that having the Home Access computer made learning more interesting, let them use a computer much more often to help them learn, and helped them to do better at school. There were also positive signs that the programme had contributed to improved ICT skills and confidence for learners, with strong agreement amongst the surveyed children that their computer skills got a lot better. Their teachers, on the other hand, found it difficult to attribute any improvements in learner motivation and behaviour to the programme, mainly since they were unsure which of their pupils had participated.

Early US initiatives

Similar programmes focused on providing access through the provision of devices and Internet connections at home have been initiated in various jurisdictions in the USA since 2005. For the most part the impacts of these early initiatives on children's learning and education outcomes have either not been evaluated or the evaluations are not easily found in the public domain and few are reported on in the academic journals. One reported on was an experiment on students in grades 6–10 in 15 different middle (most of sample) and high schools in 5 school districts in California. This intervention was evaluated for its impact on children's learning.

Middle school students from poorer backgrounds than the California average; who reported not having a home computer were eligible for the study. Of 1,123 participants, 559 were randomly assigned to a treatment group. The students received refurbished Pentium computers with 17" monitors, modems, Ethernet cards, CD drives, flash drives, Microsoft Windows, and Microsoft Office (Word, Excel, PowerPoint, Outlook) with a retail value of approximately \$400–\$500 a unit.

Average age of study participants was 12.9 years; with high concentrations of minority and non-primary English language students (55 percent Latino and 43 percent primarily speaking English at home). As well as measuring educational performance on standardised tests, the participating schools also provided a rich data set of additional educational outcomes. These included, total credits earned by the end of the third and fourth quarters, the number of unexcused absences, student lateness, and whether the student was still enrolled in the school at the end of the year.

These measures of educational outcomes complemented the results for grades and test scores. The researchers concluded that the experiment substantially increased computer ownership and usage without causing substitution away from use at school or other locations outside the home. They also found that treatment students were no more likely to be enrolled in school at the end of the year than the control students.

Overall, there was no evidence that home computers had an effect (either positive or negative) on any educational outcome, including grades, standardized test scores, or a host of other outcomes [8].

One laptop per child

Over the past decade of Internet use, interventions focusing on provision of devices to children from low socioeconomic circumstances has become a global trend, especially in developing world contexts. A number of developing countries have participated in the One Laptop per Child (OLPC) Programme promoted by Nicholas Negroponte and sponsored by various firms. Beginning in 2005, OLPC's goal was to transform education, by enabling children in low-income countries to have access to content, media and computer-programming environments through the development of low cost Internet-enabled laptops. Within this scheme, Peru purchased almost one million laptops at a cost of \$200 million. 1,000 OLPC XO laptops were provided for home use to children attending primary schools in Lima. A randomized control trial (RCT) enabled the results of 1000 children who received laptops to be compared with 1000 who did not.

The intervention increased access and use of home computers. Children with laptops scored about 0.8 standard deviations higher in a test of XO proficiency but showed lower academic effort as reported by teachers. Among students who received XO laptops in grades 3 to 5, 260 students were selected to receive high-speed Internet access at home for five months until the end of the school year in December 2012. An additional 10 training sessions and a manual for Internet use were provided to help students take full advantage of this resource.

However, no evidence was found that the intervention translated into improvements in academic achievement or in skills related to using a Windows PC or the Internet. The effect of the intervention on cognitive skills, as measured by the Raven's Progressive Matrices test, was also insignificant [9]. Similar programmes of intervention have occurred in Uruguay and Romania (See Appendix 2).

ConnectED

More recently, the policy and intervention emphasis has been towards Internet connectedness, rather than device acquisition alone. [President Obama's ConnectED](#) initiative (2009-2016) is an example. ConnectED aimed to provide better broadband access for students in rural areas, by expanding successful efforts to connect parts of the USA with trouble attracting investment in broadband infrastructure. It set out to achieve this through a range of partnerships between technology companies, e.g. Apple, Microsoft, Sprint, and Verizon, philanthropic organizations, state and federal governments.

ConnectED claimed in 2016 that it was on track to connect 99 percent of America's students to next-generation broadband and high-speed wireless in their schools and libraries by 2018. A plethora of innovations occurred under the ConnectED umbrella and only a few appear to have been studied for the outcomes. By way of example, [Sunnyside Unified School District \(USD\) in Tucson, Arizona](#), pursued strategies to connect students when off campus. Sunnyside is the 13th largest school district in Arizona with 19 schools. Nearly 90% of the district's 17,265 students identified as Hispanic; nearly 30% of the student population were classified as English language learners, and 14% receive special education services.

A preliminary formative evaluation of the Sunnyside USD intervention found that 41% of the students used their computer at home every day. They also used it in other non-school settings such as the homes of family/friends and the library. Student survey data (BrightBytes) showed that students had emerging foundational skills with technology, proficient online and multimedia skills, proficient to exemplary confidence with technology, beginning digital citizenship skills, and a strong belief with using technology in learning and daily life. However, despite all this, there were no consistent gains in school achievement tests and some negative score compared with the pre-intervention year [10].

Innovative schools digital promise

A coalition of 93 school districts, in 33 states, serving more than 3.3 million students, have now joined up across the US under the banner of the [League of Innovative Schools Digital Promise](#). Membership in the League is based on a combination of superintendent and school district qualifications. These districts are involved in partnering among leading entrepreneurs, researchers, and education leaders. For example, [Verizon Learning Schools](#) Initiative equipped every child and teacher in selected low-income middle schools across America with a tablet and **two-year data plan** as well as extensive professional learning opportunities for teachers and school leaders. Each Verizon Innovative Learning school receives a stipend for a Learning Coach to assist with program implementation, teaching support, and collaborative learning.

Links to other initiatives under the *Digital Promise* umbrella, e.g. Piedmont City School district, and Huntsville School district are found in the Table in Appendix 2. Note that all of these interventions in the ConnectED policy initiative tend to be complex in their goals and multi-stranded approach. Home Internet access and student home use, with or without a specific involvement of parents, as well as school mediation, appear common to all of these initiatives although there seems to be a great deal of customisation to meet the needs of the schools and their community.

Often, the intervention is linked to a schooling and curriculum improvement agenda. Unfortunately, few of these interventions have as yet had more than [preliminary or pilot evaluations](#) of their outcomes. Where there has been evaluation, the result is discussed in the sections to follow with the caveat that their multi-stranded, multi-goal nature makes it difficult to attribute any educational gains to the home Internet use part of the intervention alone. That is the intervention has often simultaneously focused on the school and its curriculum, the skills of teachers to be effective in an online teaching and learning environment, learning resources available to the students, 24/7 Internet access and helping parents to be effective moderators to support their children's learning and online safety. The following sections focus on evidence of the effects of the introduction of home Internet rather than broader agendas that may have been part of the intervention.

European initiatives

One-to-One policy interventions are also common in Europe. An analysis in 2013 of 31, 1:1 initiatives that involved approximately 47,000 schools and 17,500,000 students in primary and/or secondary

education across 19 European countries has found evidence of their impact on motivation; student centred learning; teaching and learning practices; learning outcomes; and parents' attitudes. These interventions were variously funded and led. Almost all the evaluation reports refer to students being more motivated when using the given devices.

However, according to some of the reports, the motivation could be maintained longer term when devices were regularly used; when students were able to work and do exercises independently with learning software giving them immediate feedback; when students had the possibility of carrying out research on the Internet, presenting the results of their work, and exchanging more easily with other students [11]. These interventions did not appear to focus specifically on the children's use of their device at home or parental moderation. The latter was noted as a gap in the design of the interventions.

Another example comes from the creation of an opportunity or online activity around which children self-organise their participation at home, sometimes with the intention of also engaging parents. In so doing the children gain new skills and positive benefits to learning, for example, Berkowitz and Schaeffer reports on the use of an App provided to 587 first graders to promote maths learning at home. In this example the parent needed to work with the child in the App and the result was significantly increased maths achievement across the school year, compared with a Reading control group [12]. In other cases, the online activity was led by a community based organisation such as a museum, in the example of PoliCultura from Italy, to promote informal learning out of school hours which can later be reinforced and built on in the classroom [13]. The importance of parental and school mediation in children's use and learning is discussed in detail in later sections.

New Zealand local or regional initiatives

We have also seen locally-led initiatives in New Zealand. The Digi-Ops projects were part-funded by the Ministry of Education in the early 2000s to accompany the Government's project-Probe initiative to connect all schools to the Internet. Individual projects were led at local and regional levels by clusters of schools and four of these were individually evaluated. While each project operated differently and had specific goals, they all had the common focus of (a) lessening the digital divide; (b) improving student outcomes, particularly in science, mathematics, and technology; and (c) providing an opportunity for trialling a government/industry/school's partnership model as Rivers and Reivers described [14].

These projects were evaluated for their effect on student achievement; other student related outcomes such as skills; attitudes and retention; management and implementation issues related to the robustness and suitability of the ICT Infrastructure; the impact on teaching and teaching staff; and programme sustainability.

The evaluations found little direct evidence to link student achievement to the implementation of the projects, with the researchers noting the difficulties in trying to establish such causal links. Students across the projects used computers to support their learning in a variety of ways and considered that their skills and confidence in use of information and communications technologies (ICT) had improved. None of the projects had a significant impact on either encouraging students to continue their studies in the target subject areas of mathematics, science and technology or on students' decision to stay at school.

An ongoing local initiative in New Zealand is [Manaiakalani](#): a cluster of schools in east Auckland formed initially with the help of the Ministry of Education's Extending High Standards across Schools funding. The explicit focus was on lifting the quality of teaching and learning in all the schools in the cluster and

a specific goal was to ‘engage students in the use of technologies that allow them to practice, produce, present and publish in something other than the media of historic failure’.

Digital devices and the Internet have become a core part of teaching and learning in the schools and this has also extended into the children’s homes as an important other site for children to learn self-regulation and digital skills. Research and evaluations continue to track children’s learning progress across core areas of literacy and numeracy.

For example, Jesson’s 2015 research involved 40 students with a range of ethnicities (mainly Māori, Tongan, and Samoan) and year levels (Years 5–13) and their parents/caregivers (37 mothers, 9 fathers) and 22 teachers from six schools showed the complex interdependency between children’s learning outcomes, teacher facilitation and parental mediation [15]. Evaluations for this project to date focus on pedagogical practices rather than educational outcomes.

Other clusters of schools around New Zealand, especially those in low socio-economic communities, have introduced schemes similar to Manaiakalani where Trusts are set up and families could purchase dedicated netbooks through the school that the child uses at home and school. In these schemes it is up to the families to provide Internet access beyond school. An evaluation of one of these schemes compared the achievement of students who purchased a netbook against those who did not [16, 17]. E-asTTle, PAT maths and STAR scores across two years were measured. Linear regression and propensity score matching was undertaken to evaluate whether ownership of a netbook made a difference to achievement and achievement progress in literacy and numeracy.

While the results above indicated that students with a netbook did slightly better at structure and language in 2016 and worse in punctuation in 2015 the differences were not repeated across the two years. The propensity score matching and linear regression showed no significant difference between the two groups in most of the measures although students with netbook and lower reading ability made slightly better progress in their reading scores compared to their peers and netbook owners made slightly more progress in their vocabulary. Home Internet access was not a direct measure against these results.

Other initiatives

In some countries it is noted that there are policies in place either at the national, regional or city level to make home Internet freely available to all young people. In the case of Singapore there is a household income-targeted scheme. It provides a two-year subsidy for Singapore citizen applicants under the age of 25 and studying at school or post school to own a new computer with free software and three years of free subscription to broadband services. Where the applicant is unable to meet the cost of the co-payment, there is an additional scheme for those with lower household incomes to receive the services through a grant in return for 3-12 hours of community service. As another example, the [Norwegian town of Bergen](#), provides online access for all children.

A different type of intervention involved the creation of an opportunity or online activity around which children self-organise their participation at home, sometimes with the intention of also engaging parents. In so doing the children gain new skills and positive benefits to learning, for example, Berkowitz and Schaeffer reports on the use of an App provided to 587 first graders to promote maths learning at home. In this example the parent needed to work with the child in the App and the result was significantly increased maths achievement across the school year, compared with a Reading control group [12]. In other cases the online activity was led by a community based organisation such as a museum, in the example of PoliCultura from Italy, to promote informal learning out of school hours which can later be reinforced and built on in the classroom [13]. The importance of parental and

school medication in children's use and learning is discussed in detail in later sections. More generic approaches to intervention involve the use of the internet for homework tasks set by the school (for example, [Dodson \[18\]](#)). In this instance, student performance on the homework task was higher using pen and paper.

Surveys to simply understand the extent of home Internet use and create baseline data are a common intervention. For instance, in the UK, the [Oxford Internet Institute at Oxford University](#) has been regularly surveying patterns of home Internet access and use [19]. The [Pew Internet in American Life](#) plays a similar role in the USA. Other countries have also followed this pattern (e.g. [Duarte, Cazelli \[20\]](#)). In New Zealand, this type of role has been picked up by the [Internet New Zealand Survey](#) conducted by Institute of Culture, Discourse & Communication at Auckland University of Technology, NZ [21]. The value of these measurement interventions is that they firstly, raise awareness of the state of the new 'normal' as the Internet becomes more pervasive; secondly, they show changing patterns of use and aspects of who is participating, how and for what and who is not. That is individual decisions, organisational decisions and policy decisions to make some change in respect of the new and changing 'normal' can be made on the basis of this knowledge.

Impact of home Internet access on educational outcomes

This section is divided into three parts to present the results of three main questions. First, how is educational value measured in the reviewed articles? Second, what does the literature say about the educational value of home Internet access? In other words, what are the positive, negative, or neutral effects of having home Internet access on children's education? Finally, what are the conditions or factors that influence the educational value of home Internet access?

How is educational value measured?

Among the 138 analysed articles included in this review, 68 have addressed the educational value of home Internet access. We classified these studies into three categories (Figure 2. Classification of the studies on educational value):

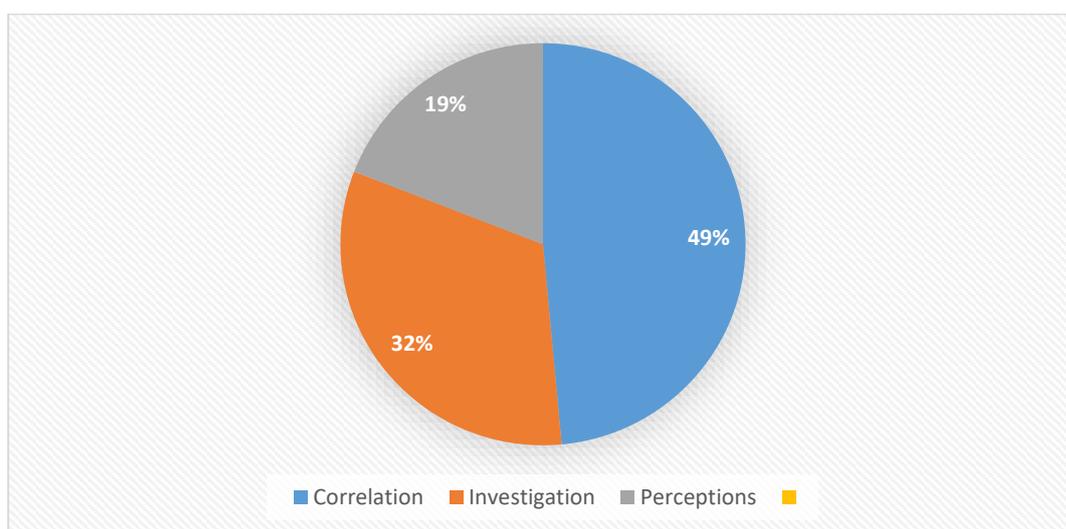


Figure 2. Classification of the studies on educational value

1. **Correlation-focused studies:** The focus of 33 studies were to examine the relationship between having home Internet access and different educational aspects. These studies used questionnaires/surveys to explore whether the relationship between home Internet access and specific educational aspects is positive, negative, or neutral/weak. Correlational studies

can indicate the existence of the relationship between variables but cannot indicate that one variable is the result of the other [22]. In other words, these studies can indicate whether home Internet access is related to educational outcomes without claiming causality.

2. **Perspectives-focused studies:** These 13 studies focused on exploring students', parents' and to lesser extent teachers' views and opinions about the impact of home Internet access on students' education. These studies used questionnaires/surveys and/or interviews/focus group to explore peoples' perceptions.
3. **Investigation-focused studies:** Although the studies above investigated the relationships and the perceptions, this category includes 22 further studies that explored the impact of home Internet access. In these studies, a combination of methods like pre-post-tests, questionnaires, experimental approach, case studies, interviews, focus group, and logs were used to explore, measure, or evaluate the positive, negative, or no-impact of home Internet access on different aspects of education.

The following sections will illustrate the contribution of each category in addressing the educational value of home Internet access.

The educational value of home Internet access

From the studies of this review, educational value is grouped into three domains: the learning domain which includes formal and informal learning, the psychological domain, and the social domain (Figure 3. Domains of educational value).

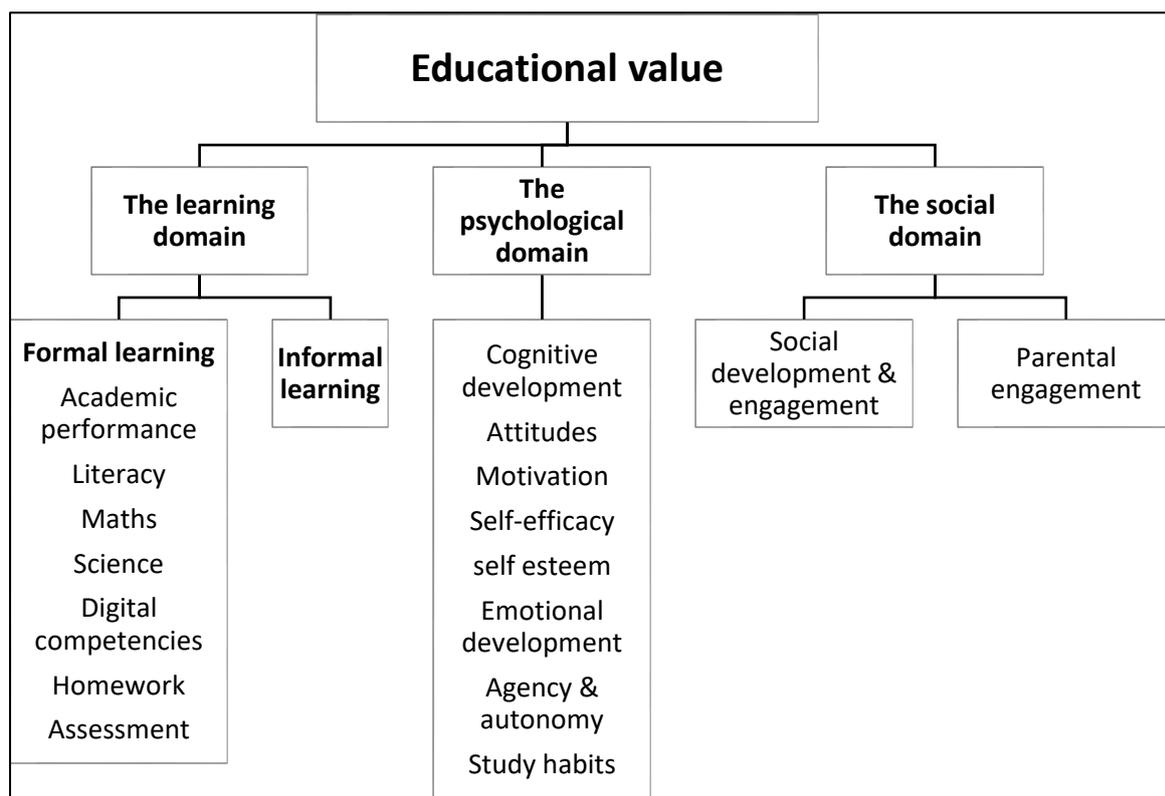


Figure 3. Domains of educational value

The learning domain

The research articles that evaluated were analysed to identify positive, neutral and negative educational value of home Internet access for different aspects of learning. The results are summarised in Figure 4

Equitable digital access to the Internet beyond school: A literature review

and explained further in the following paragraphs. Details of which articles are referred to in Figure 4 is included in Appendix 3

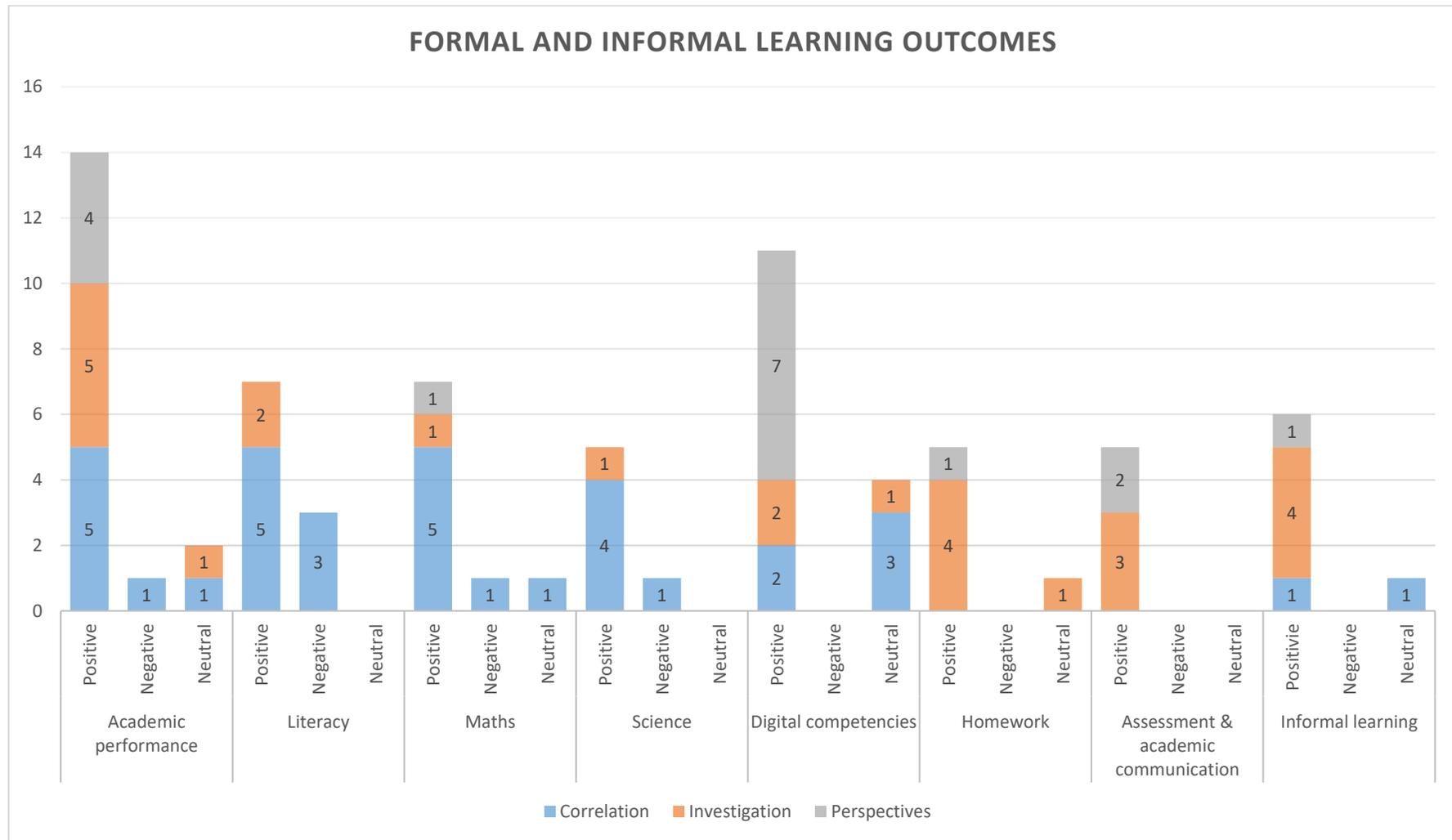


Figure 4. The learning domain

Formal learning

Academic performance: Five studies indicated a positive correlation between home Internet access and students' general academic performance. This positive relationship existed for children from high socio-economic families who provide home Internet access [23, 24] or students from low-income communities who were provided with access [25]. A further positive correlation appeared when children spend less time playing computer games [26] or the use the Internet for learning [27]. The latter also reported that general use of the Internet in some cases is related negatively to school performance, while another study found no relationship to student achievement [28].

Students and parents believe that home Internet access has a positive impact on students' education and their academic performance at school [29-32]. Five studies examined this impact further, and one of them found it has a positive impact on students' formal learning [33]. The other four have evaluated initiatives that provided home Internet access to low socio-economic communities and resulted in improvement of students' achievement [34-36] and in some cases, this was attributed to spending more time on learning activities, having guidelines to search and manage distraction, school role, and parents' learning support [15]. One study found no impact on students' school performance if the schools did not invest in Internet technology effectively [37].

Literacy: Studies reported that using the Internet at home is positively associated with achievements in literacy. Many factors play a role in this positive relationship like gender (favouring girls), how students use the Internet for leisure (favouring communication activities), using it for online learning, or playing games only in the weekends [38-40]. Also, age, time spent on the Internet, type of applications, and the high socio-economic class of the family correlate with literacy outcomes [41, 42]. Studies drew attention that unplanned and undirected use of the Internet at home or entertainment use beside the low socio-economic status is associated with low literacy achievements [41-43]. In contrast, two studies investigated the impact of having home Internet access and found that students literacy scores increased [44] and literacy skills were enhanced for students who participated in a specific initiative for immigrant families [45].

Maths: Seven studies identified a positive relationship between home Internet access and maths achievement [28, 46] which is sometimes associated with high socio-economic status [42] or how students use the Internet at home [38, 40]. Nevertheless, one study indicated that this relationship is weak [43] and a negative correlation was identified when students were from low socio-economic communities [42]. However, a study found that students' maths achievement had increased significantly after using online educational intervention at home with the parents [12].

Science: Five studies reported the positive relationship between having home Internet access and science learning [28, 47, 48] especially when time spent on playing computer games is controlled [40]. Further examination showed that online science homework helped students to enhance their overall score in science [18]. Interestingly, one study found that some socioeconomic variables including home Internet access have a negative relationship with science achievement [49].

Digital competencies: Unsurprisingly, none of the studies reported a negative relationship or impact of home Internet access on developing digital competencies. By contrast, students perceived that having home Internet access has a positive impact on their digital literacy [30, 50, 51] and provide a valuable resource for learning and finding information [52, 53]. Parents' perceptions were similar [31, 54]. A deeper analysis found that digitally competent students have behavioural merits like organized, critical, and strategic thinking that shape how they use the Internet [55]. This positive influence is more likely to happen with supportive, non-controlling parents [56].

Home Internet access is identified as a significant predictor of adolescents' Internet savviness [57]. It has a positive relationship with students' new media literacy [58], students' digital competencies [20] and students' from low-income families [25]. On the other hand, in some studies, no relationship was found between home Internet access and digital competencies [59, 60] or for students with learning disabilities [61]. This was more apparent in developing countries when testing whether providing a laptop per student with Internet access at home will improve students' digital skills where no evidence of improvement was found [62].

Homework: Parents believe that having home Internet access has helped their children to engage in their homework [29]. Three studies investigated the impact of home Internet access and found that it motivates students to do their homework [63], make it easier [34] and enable students to achieve better grades regardless parenting style [64]. At the same time, not having Internet at home sometimes hinders students' ability to do homework [65]. In some cases, the Internet was found to have no impact on homework grades per se, yet may improve overall grades [18].

Assessment & Academic communication: When applying innovative learning approaches like blended learning or collaborative learning, students [53] and parents [66] said that home Internet access facilitates the communication between students and their teachers and peers. This was supported by studies that investigated this kind of access for a collaborative learning program [67] and students from low socio-economic communities [63]. Having home Internet access enables students and teachers to take advantages of some innovative online homework applications which may include formative assessment [68].

Informal learning

There is a significant gap between students who have home Internet access and those who do not related to opportunities for learning favouring those who have [69]. A large-scale mixed methods study investigated how young people use technology at home in the UK and found that the benefits of the Internet at home go beyond the formal learning to informal or accidental learning [33]. This is supported by other studies that evaluated the outcomes of three initiatives in the UK [37] Australia [34] and Italy [13] which found that opportunities for informal and independent learning increases when children have home Internet access because of the availability of the resources and the ease of communication. Parents believed that this technology prepares their children for their future careers [70]. However, these benefits are not always guaranteed, for example, having Internet at home has no relation to the democracy awareness of the Turkish students [71].

The psychological domain

In this domain, most of the studies have reported a positive relationship or impact of home Internet access on children psychological and cognitive development (Table 1). Three studies found a positive relationship between using the Internet at home and cognitive development during middle childhood also has a positive relationship with self-esteem [72-74] attitudes towards technology [75] and self-efficacy [25, 76, 77] and when self-efficacy is enhanced students' achievement at school improves as well [78]. One study reported the negative relationship between socioeconomic variables including home Internet access with cognitive development [49]. While no relationship was found with cognitive development in the case of children using the Internet for playing or browsing [72] and no relationship between online behaviour at home and emotional development [74]. Finally, having home Internet access has a positive relationship with children' habituation to computer use which in turn was found to delay the socio-emotional development [79].

Regarding students' perceptions, students felt self-improvement and a sense of empowerment when starting to use the Internet at home [51], positive attitudes towards technology [30, 80] and improvement in their study habits [50, 53]. Positive impacts were also identified for motivation of students from low-socio-economic

communities [63] and agency and autonomy [33, 63, 81]. One study reported that students decreased their efforts at school and believed that the Internet has no impact on their cognitive skills [62]. In some cases, immigrant children expressed increased confidence, motivation, and sense of responsibility when able to access the Internet from home as a part of a special program [45].

Table 1. The psychological domain

	Correlation	Investigation	Perceptions
Positive	Cognitive development (3)	Motivation (2)	Attitudes towards technology (2)
	Attitudes towards technology (1)	Agency & autonomy (3)	Self-improvement and sense of empowerment (1)
	Self-efficacy (4)	Confidence (1)	Study habits (2)
	Self-esteem (2)	Sense of responsibility (1)	
Negative	Cognitive development (1)	Efforts at school (1)	
	Socio-emotional development (1)		
Neutral	Cognitive development (1)	Cognitive development (1)	
	Emotional development (1)		

The social domain

Unlike a common belief that children's Internet use at home has a negative impact on the social life of the young generation, all but one of the reviewed studies indicated that having home Internet access is associated positively with children's social skills alongside the engagement of parents in their child's education (Figure 5. The social domain).

Using the Internet at home has a positive correlation with social development [74] and family and peers' relationships for children from low-income families [25]. Children's social skills improve when participating in some programs that target immigrant families [45], low-socioeconomic communities [34] or use certain online applications [82]. Children felt that the Internet helped them to integrate into the social fabric [51] which was also a positive result when evaluating the outcomes of a one to one initiative in the UK [81]. An indirect negative impact on the development of social development was found as a result of children's habituation to computer overuse [79].

Home Internet access has a positive impact on parental engagement with their children's education. Parents said that Internet was one of the main resources that enabled them to follow up and supervise not only their child's academic performance [83] but also their personal and social wellness at school [31] and allowed them to participate in some of their learning activities [84]. Parents' engagement with their children's education is evident in research exploring home Internet initiatives in the UK [37], New Zealand [85], and Australia [34].

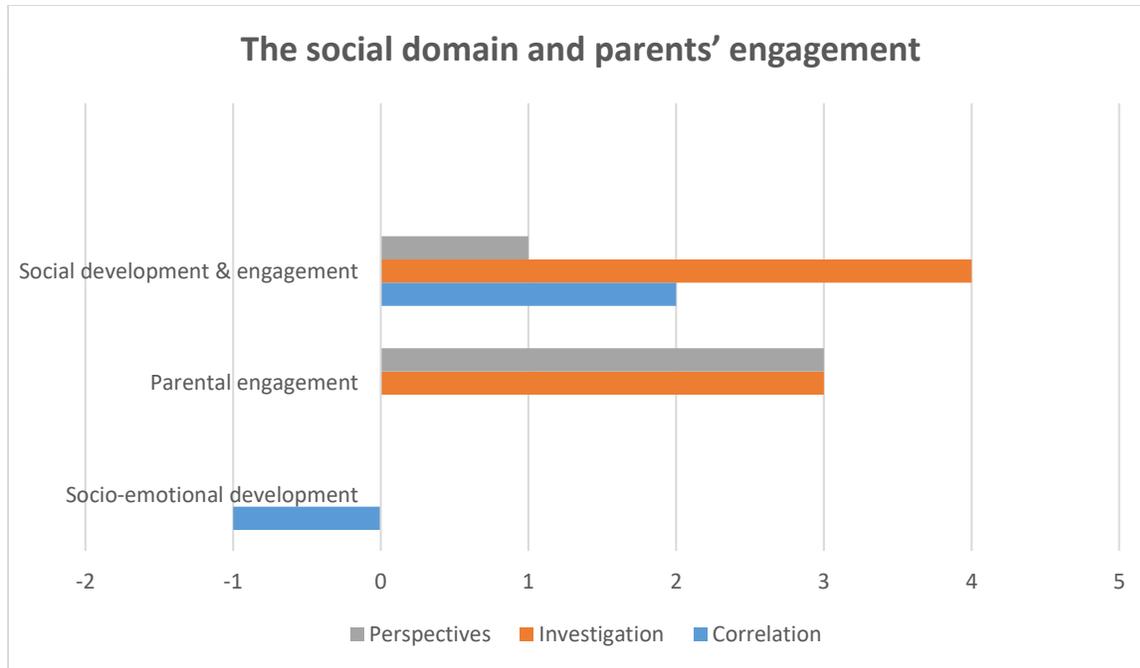


Figure 5. The social domain

The conditions or factors that influence educational value

From the previous section, many factors that interact and influence the educational value of home Internet access come to the surface. These factors can be classified into three types: the factors related to the children themselves, the factors related to the family context, and the factors related to the school context (Figure 6. Factors influencing the educational value of home Internet access).

Factors related to children: Although age and gender may play a role in how students benefit from home Internet access [62] these differences are not isolated from the other factors. For example, because girls more likely tend to use the Internet for communication and accomplishment this resulted in more positive outcomes for them over the boys who spend more time on playing computer games in their leisure time [39, 73]. On the other hand, positive outcomes are related to other types of usage like studying, learning activities, and online reading [27, 39, 72]. In addition, students who have positive attitudes towards technology [80] and who developed strategies to search and manage distraction on the Internet [55] or students who show cognitive skills and organisational habits [15, 55] gain more benefits when they use Internet at home. One of the influential factors is time spent on the Internet at home. To achieve positive outcome children, need to spend enough time for learning on the Internet [15, 20, 41] and not too much time playing computer games, especially during the week [26, 40].

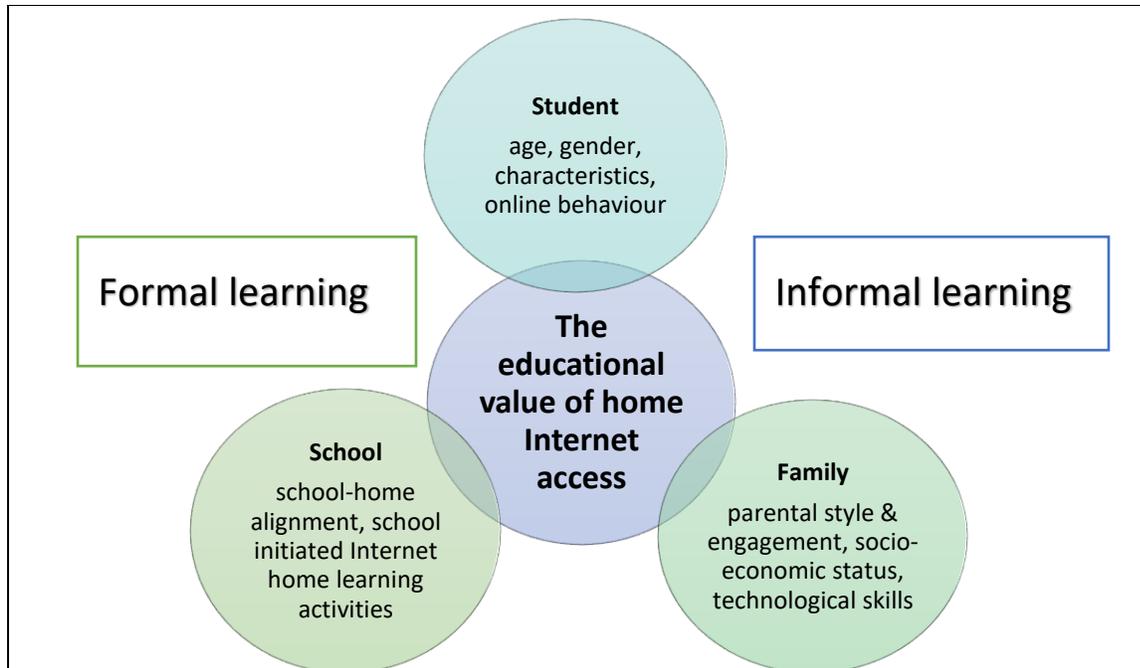


Figure 6. Factors influencing the educational value of home Internet access

Factors related to the family context: Higher socio-economic status is related to positive outcomes of Internet use at home [42]. Also, children of parents who have technological skills and are involved in online school learning activities are more likely to gain benefits of home Internet access [12, 66]. Educational value is also improved where supportive parents provide guidelines, advice, and encouragement help their children to use the Internet at home effectively [15, 56, 64, 66]. The home context will be discussed in the next section of this report.

Factors related to school: This is another important factor that will be discussed further in the upcoming sections. School-home alignment [15] and how schools utilise the Internet technology to engage students in home learning [63] are aspects related to the educational value of home Internet access. In addition, for teachers to be confident in their ability to infuse Internet based learning activities into their teaching programme requires confidence and knowledge of how to integrate technology [86] when their students have home Internet access [37].

The Home Context

Globally, children are accessing the Internet from home. A study of 533 parents of primary children in fifth and sixth grades in Belgium explored children's use of the Internet. They found that 91% of children had access to the Internet at home [87]. This result is consistent with Geyer's [57] study of 677 adolescents aged 8 to 14 years old in the USA, where 76.1% of participants reported having broadband access to the Internet at home. Similarly, a Turkish study of 366 primary students aged from 6 to 13 found that 61.9% of students were offered home Internet access and 95.8% of them used it [88]. A more recent report on the use of technologies for teaching and learning in New Zealand revealed that 81% of Year 4 students and 94% Year 8 students had Internet access at home [89]. This finding is consistent with a study exploring home digital access and use of 787 Year 12 students in 56 schools across New Zealand where 88% of students reported they had access to the Internet at home [90].

Access to the Internet at home varies within and across contexts. Children in rural areas have poorer or constrained access to the Internet when compared to their urban peers, but this access is improving [91]. Analysing data from a survey of 2559 15-year-old children in rural areas of the United States, Mardis concluded that the children's limited access to broadband at home was *"due to issues related to the availability and cost"* [91]. In contrast, [Sampath Kumar and Basavaraja \[92\]](#) found that in India nearly 70% of rural students had not used a computer as it was not available in either their home or school. As referred to previously, in 2012 the *One Laptop per Child* programme provided laptops with connectivity to 1,000 primary children in Peru, resulting in children's extensive and intensive use of computers and Internet at home [62]. A follow-up initiative of the same programme provided students with Internet access at home [62]. Another example is drawn from a study conducted by Alshehri [64] about the use of Internet in Saudi Arabia to complete and submit homework among students in Year 10, 11, and 12. Findings showed that *"the usage of Internet in Saudi Arabia are increasing based on the availability of right technologies in the majority of home"* [64]. The advance of various technologies has offered students various use of the Internet.

Children's home Internet use for general purposes

Children's use of the Internet at home occurs for a wide range of purposes. Studies exploring children's home Internet use through surveys produce variable results due to differences in context, age of participants, and survey design. Table 2 summarises results drawn from a representative cross-section of recent studies from around the world. These can be grouped into four broad categories: entertainment, communication, collaboration, and education, the following sections consider the four categories in turn.

Entertainment.

Playing online games is a significant online activity globally and accounts for high levels of children's Internet use [26, 93, 94]. However, this is not the case in all studies. In Jesson's New Zealand study, the focus was on educational use of netbooks for learning and only four out of 40 students reported playing games in the interview and they thought that this was not learning-related activity [95]. The number was also low in rural Vietnam which may reflect constrained access [96]. Another entertainment activity among children was watching movies or video clips on the Internet. This was most preferred by children in urban areas of Vietnam [96], Greece [97] and through YouTube in New Zealand [98]. Children also liked to listen to music, surf the Internet for fun, download music and read the news. There appears to be minimal age-related difference between the data sets.

Communication

The Internet enables students to communicate with other people beyond their home environment. There are different ways available online for children to use in their communication. Children in urban Vietnam, China and the U.S chat online. Some of these children, especially in urban Vietnam [96] and the U.S [99] use email to communicate. There may be an age and access related difference in communication styles with less online communication in the younger children and rural children in Vietnam. This aligns with findings from a New Zealand study that found that 10-year olds predominantly only communicate with family online and a small number of friends, but expect this to change as they transitioned into adolescence [100].

Collaboration

Internet access together with digital technology offer children opportunities to collaborate with others. Social networks such as Facebook, Twitter, Instagram or Snapchat are popular in teenager's use of the Internet, with YouTube and Snapchat used most often by US teenagers [101]. However, few of the children in the studies appeared to be using social media. Sites such as Facebook commonly have age restrictions of 13 years, which may explain why it is the studies with older students that reported children joining different groups on Facebook, such as the Brazilian study [20]. In urban Vietnam, blogging and social media and file sharing were also commonly used by children [96]. Children in the studies reported using the Internet at home for other purposes such as searching for personal use, commercial interests or purchasing online [32, 97, 99].

Education

Pisa 2015 [102] examined students online behaviour in a very broad educational context considering academic task completion, parental involvement, social media and cyber harassment and bullying, and overall time spent online across all activities as all having a clear influence on the education value of connectivity. There are clear educational benefits and attendant risks that come with being online and there is no one clear solution that addresses everything.

In summary, children have reported spending different amounts of time on their online activities. For example, among 52.8% of the students having Internet access at home in Greece, 33% reported using it for less than an hour a day [97]. This compares to US teenagers, 95% who have a smartphone and 45% report they are almost constantly online, and 44% report being online several times a day [101]. These studies are from different times, the US study is 10 years after the Greek study, and of different aged students. It is likely that globally teenagers are more connected to the Internet now than in the past with mobile devices.

Children's use of the Internet for learning at home.

This section outlines recent research from the New Zealand context then analyses literature from the global context to understand how children use the Internet for learning at home. The section concludes with the implications for how home use might influence the educational value of the Internet.

Research from the Manaiaikalani initiative in New Zealand identifies that students used netbooks at home and school as a tool for learning including to access, evaluate, and apply information, to create artefacts about their new knowledge, and to share their learning, via blogs, with their families, peers, and the wider public. Students to access resources and learning tasks through Google tools. Students share their artefacts or activities with the teacher for feedback. Using individual blogs, students' learning is also shared with their families, allowing families to see what students have been learning at school. Students reported engaging in maths practice using sites and apps (38 percent), fiction and non-fiction reading (45 percent), and writing (15 percent). Students also reported posting to a blog, commenting on others' blogs, and preparing blog posts [95].

Table 2. Children’s use of the Internet at home.

Authors (year)	Aslanidou (2008)	Casey (2012)	Duarte (2013)	Nguyen (2018)		Anderson (2018)	Lei (2009)		Selwyn (2009)	Jesson (2015)	Brunton (2015)
Age of children (years)	12 - 18	9	12 - 18	9 - 11		13-19	12 - 13		7 - 11	11 – 18	6 - 13
	Greece	Ireland	Brazil	Vietnam		US	U.S	China	UK	New Zealand	New Zealand
				(Rural)	(Urban)						
ENTERTAINMENT											
Playing games	55 %	86 %	70 %	36 %	64 %		63 %	68 %	67 %	10 %	76 %
Listening to music	78 %								8%		18 %
Listen to radio online											3 %
Watching movies / video clips	48 %	28 %	30 %	26 %	74 %				18 %		31 %
Watch Youtube						85%					75 %
Surf the Internet for fun		48 %					66 %	36 %	4 %		10%
Downloading music		28 %	43 %				53 %	61 %		10 %	10 %
Downloading movies											11 %
Reading news				24 %	75 %		28 %	27 %			
COMMUNICATION											
Communicating	61 %										
Chatting		13 %		15 %	85 %		70 %	78 %	35 %		
Emailing		13 %		7 %	85 %		74 %	26 %	38 %		
Instant messaging		6 %		15 %	93 %		29%	24 %			
Skype, MSN			57 %								
COLLABORATION											
Social networking			59 %			Instagram 72% Snapchat 69% Facebook 51% Twitter 32%			12 %	10 %	25 %
Blogging				3 %	82 %						
File-sharing sites				16 %	84 %						
Updating news on social media				21 %	80 %						
EDUCATION											

Equitable digital access to the Internet beyond school: A literature review

Doing homework		26 %	27 %								
Searching for schoolwork / school projects	47 %	47 %		27 %	73 %		85 %	80 %	11 %		
Using learning practice websites / applications			27 %						12 %	38 %	
Writing and reading										60 %	
ICT skills	40 %								2 %		
OTHER PURPOSES											
Searching for personal use	92 %						63 %	35 %	15 %		
Commercial interests									4 %		
Online purchase, auction, shopping	10 %								3 %		

Children's use of the Internet for learning at home.

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A range of home learning activities were identified in a study of 9-12-year olds' use of netbooks in a low socio-economic community in New Zealand [63]. The Internet was used to access information for inquiry-based projects and curriculum specific websites provided skill development activities. Children completed online worksheets which matched printed versions that students without netbooks used. Presentation software such as Google docs and slides were used to record and present their work and an e-learning portal enabled communication between the student and the teacher.

A study that explored how a diverse sample of 9-11 year old New Zealanders use digital technologies for learning found students to be using the Internet at home for learning through the use of Google tools such as Google classroom, sharing documents, collaborating with peers online, using apps for learning and developing digital objects through within programmes such as Minecraft or Scratch [100]. This suggests that children are using the Internet for learning in diverse ways across New Zealand.

To analyse how children are using the Internet for learning globally, evidence in the literature was collated against the digital age learning matrix [103]. Evidence was grouped within five categories of use; accessing information, presenting information, processing or creating digital objects, gaming or the use of interactive programmes for learning and communicating or collaborating (Table 3).

Table 3. Children's use of the Internet for learning at home.

Study	Accessing information	Presenting information	Processing or creating digital objects	Gaming or interactive programmes for learning	Communicating or collaborating.
Aslanidou 2008	x				x
Asselin 2010	x	x	x		
Duarte 2013	x			x	
Foss 2013	x				x
Furlong 2012	x	x			x
Gurung 2014	x	x		x	
Jesson 2015	x	x		x	x
Kolikant 2010	x				
Kooiman 2015				x	x
Lei 2009	x				
Lips 2017	x	x	x	x	x
Starkey 2017	x	x		x	x
Wilkin 2017	x	x		x	x

Accessing information was the most commonly reported use of the Internet for learning at home in studies from across the world. For example, a study that compared Chinese and US middle school students' use of the Internet at home found that accessing information from the Internet was the dominant homework activity in both countries [99]. In New Zealand the Internet was used to access information for inquiry type projects [63] and nearly half the children aged 12-18 in a Greek study reported that they often to always using the Internet at home to access information for homework [97]. How children search for information varies with age, for example, adolescents have been found to be social in their use of the Internet for accessing information and have a wider range of search strategies than younger children [104].

Presenting information as a home learning activity using the Internet includes blogging, writing in Google docs or slides [95] or developing a YouTube video [100]. The information being presented varies from what had been found in an inquiry, to a specific homework activity that had been directed by the teacher [63].

Communicating or collaborating identified in the research is between students, between students and their teacher [63] and between students and their families [95]. The communication and collaboration appear to change with age with 12-18 year olds more prolific in their communication with friends than younger students. The communication occurs through email, messaging, video messaging or an e-learning portal. Communicating and collaborating was identified as sharing learning, a social activity by Furlong and Davies [33]

Gaming or interactive programmes for learning includes a range of types of learning activities carried out at home. This includes learning through multimedia online learning activities that have multiple components such as video and quizzes that the teacher can set and monitor progress through learning management systems [105], or curriculum specific websites designed for student learning such as Khan academy, Mathletics, Sumdog, Studyladder [106] or exergames. Exergames are interactive collaborative games played through the Internet or gaming technology such as a Playstation that require the learner to physically immerse themselves with body movements and can help students access the cognitive, physical, emotional, and social aspects of a physical education curriculum [82].

The least mentioned category was processing or creating digital objects. However, there was evidence that children were creating objects through programmes such as Scratch and Minecraft [100] and a study of how two students (aged 12 and 15) used the Internet for home learning in Canada students were found to be using Photoshop [107]. While this category was not identified across the research, it may be that activities such as processing information in a spreadsheet or coding activities were not identified separately to 'homework' activities. In a number of studies, the data was restricted by questions asking about specific uses. For example, looking for information, communication, playing games, buying products [97] or 'doing homework and projects [38] and where this was the case creating digital objects and online collaborations were not distinguishable.

The analysis of the data drew from a range of study designs. Some studies focussed on a specific use of the Internet for learning such as Kooiman and Sheehan [82]. Other studies recorded activities students or their parents reported through interviews or survey where some of the categories in the matrix were not included as an option. Therefore, while the analysis in Table 3 can give an indication that the dominant use of the Internet for learning at home is accessing information, followed by communicating or collaborating, presenting information and gaming, with few examples found of students processing information or creating digital objects, this may not be accurate due to the limitations of the data in the studies.

The educational value of the types of learning activities is unclear across the literature. Accessing information and presenting may align with lower order thinking or a passive style of learning in which the student is locating information and presenting this which may have limited educational value. It may or may not involve analysis and higher order thinking skills such as critical and creative thinking or developing disciplinary conceptual understanding. The use of collaboration and communication for learning could have high educational value although it may have a low value in terms of an achievement outcomes measured in high stakes testing. The category most likely to involve higher order thinking is processing or creating digital objects, which was also

the category least often reported. Further research is needed that explores the educational value of different types of home learning Internet activities.

Many of the studies did not distinguish between educational and leisure use of the Internet at home, therefore it was not clear whether communicating, gaming and surfing the Internet was for formal, informal learning or leisure (for example, Duarte, Cazelli [20], Johnson [108]). The complexity of the overlap between formal and informal learning when using the Internet was noted in two studies [33, 109]. Both also suggested that when students are using the Internet at home they may switch between learning and leisure activities. For example, searching for information while chatting with friends through instant messaging or watching a YouTube clip that attracts their attention.

A positive outcome of Internet use at home for learning is children's increased autonomy or sense of agency. Children from England aged 11-18 reported appreciating the greater control they had over their learning through the Internet [81]. The Internet kept them up to date with what was going on in their social circles, enabled them to complete homework tasks, provided entertainment and a means to look up simple information. For some students, the home learning environment meant that they felt more motivated to complete homework and make progress in their subjects.

In Jordan, parents noted that children aged 4-10 familiarized themselves with computer functions and technological skills including chatting, e-mail, and digital games [54]. The self directness of student learning was also noted in recent studies from New Zealand [63, 95]. Children in low socio-economic communities using the Internet for learning were found to be confident in what type of homework activities they were going to do and how. The children independently undertook the homework and, in many cases, had technical and curriculum knowledge that their parents lacked.

The use of the Internet for learning at home is one aspect of schooling systems which influences student perspectives of the value of the use and the system. Secondary school students using the Internet for learning at home in Israel reported that they believed school learning had limited value beyond qualifications as they could access information they valued through the Internet [110]. The use of the Internet for learning was a strong theme in research from England that asked children aged 7-11 their perception of the learning benefits of using ICT [32]. A range of learning aspects were identified including finding out new things, learning to make and create things and doing other things that they could not do before. Pupils were less likely to indicate that they felt they used ICT for learning maths, revising for tests or learning to read at home.

While OECD children use of the Internet at home appear to not be influenced by social inequalities or demographic factors as family structure, gender or immigrant background [111], this might not be the case when examining how the Internet is used for learning. One study in this review used two big data analytic tools to examine interest in and usage of two popular websites that primarily target children and adolescents: KhanAcademy.org and CartoonNetwork.com [112]. The former represents a capital-enhancing use of the Internet, while the latter represents an Internet use for entertainment. Data analysis revealed that high sociodemographic status was positively correlated with interest in Khan Academy, while low sociodemographic status was positively correlated with interest in Cartoon Network. This suggests that existing educational inequalities may be reproduced through unequal Internet use without children being guided in their Internet use.

Children use the Internet for learning in a range of activities at home. The dominant use was to access information. However, the educational value of the different types of home learning activities is unclear and further research should consider this question within the context of future focused curriculum aims. A positive outcome from learning at home through the Internet in the home is an increased sense of agency and autonomy in learning. However, there is a danger that the types of use may reproduce existing inequities without the guidance of the teaching profession.

Parents' perception of children's Internet use at home

Global researchers have investigated children's use of the Internet from their parents' perspectives. In Jordan, a survey was conducted to examine parents' perception on their children's Internet use at home. Participants included 570 parents of K-2 children (kindergarten, 1st grade, and 2nd grade) from 15 kindergartens and 40 primary schools. Completing the questionnaire, parents believed the children's most preferred activity using the Internet was playing online games, followed by visiting websites and checking information for fun [113]. This echoes the result in a previous study exploring parental perspectives about the effects of computer technology on children. 85% of 127 participating parents in the city of Amman reported having Internet access at home. These parents believed that their children most commonly used the Internet for searching information (52%), followed by entertainment (39%), email (28%) and homework (20%) [54]. In Canada, 151 parents of students in first through sixth grades participating in the study were asked about their children's online behaviour at home. Answering questionnaires, 90% of these parents said that their children used the Internet at home for different purposes such as *learning* (schoolwork, maths practice, research for assignments), *playing* (games, have fun with friends), *browsing* (visit websites, find things of interest), and *communicating* (email, chat). Among those, learning accounted for 43%, followed by playing with 37.7%, browsing with 23.2% and online communication with 17.9% [72]. The issue is whether all activities mentioned can positively impact the development of children. Above all, parents want to ensure that their children can take the educational advantages from the Internet [70].

Parents in low socio-economic communities believe it is important for their children to use the Internet and digital technologies for learning. A study conducted in New Zealand investigated the perspectives of parents, teachers and students from primary and secondary schools on home learning in a digital environment. Parents in 40 families in the first interviews and 30 families in the second interviews were from a range of ethnicities: Tongan (28%), Māori (23%), Samoan (20%), Cook Island (10%), New Zealand European (10%), Niue (5%) and other Pacific and Asian nations (6%). These parents recognized the potential and opportunities of their children's learning through using digital technology. They described home learning activities as "homework" including communication uses (email; online chat; Skype; Twitter), social or personal use (YouTube; Facebook/social networking), blogging, searching, using maths games and spelling applications. The findings showed parents' engagement in their children's learning in the home context [95]. This is consistent with findings from a study conducted in the United States. 50 African-American low-income (below \$30,000) families from six rural parishes in northeast Louisiana with school-age children participated in the study that aimed to assess the educational values of home Internet access from parents' perspectives. Results revealed that 85% of the families had positive responses on the impact of home Internet access and "parents said that Internet access at home afforded their children with a valuable resource that enhanced the at-home learning environment" [29].

Parents have concerns about children's use of the Internet at home as they "are aware that their children can be vulnerable to online dangers" [114]. In Crete (Greece), a research aimed to examine parents' perceptions and attitudes towards possible dangers for children when surfing the Internet. 1,503 parents of primary students (in 4th, 5th and 6th grades) were invited to complete a questionnaire. Most participants reported knowing the possible risks that their children may encounter using the Internet for both educational and recreational purposes. However, findings showed that these parents "generally underestimated their children's exposure to negative Internet content" [115]. A Swedish survey of parents' concerns about their teenage children's use of the Internet identified concerns including being bullied, becoming passive, dangerous people and negative content (pornography, violent images, hatred or distressing material). The authors concluded that "the more important the parents considered the Internet to be for the teenagers' development and way of life, the more worried they were" [116].

Parents play a role in children's use of the Internet at home with some awareness of the potential risk that children may face when they use the Internet. How parents monitor or navigate children's use of the Internet can influence the educational value of the Internet at home.

Factors that influence children's Internet use

Studies have found different factors influencing children's use of the Internet at home. These factors are identified as children's gender, age, geographical stratification and socio-economic context of children's families. The influences have resulted in differences in children's online activities, their time spent on the Internet and online behaviours.

Gender correlates with what children do on the Internet at home. Boys spend more time playing games than girls [20, 79, 93, 96, 97] and girls spend more time on the Internet socializing and on academic activities such as doing homework or searching information for schoolwork [117]. However, no difference was found between the time that boys and girls spend on the Internet [96].

Age is an important factor influencing children's Internet use at home [19]. Studies have found more Internet use among school age children compared to older age range and children of different ages use the Internet differently. For example, younger children use the Internet to play games at home and teenagers preferred social networking. The type of games played changed with age. Pepe [26] found that children aged 12 – 13 liked playing mind games while those at the age of 14 – 15 played sportive, action and fighting games. Differences also exist in children's level of socialization and purpose of using the Internet. In Greece, children aged 12 – 15 reported preferring to use the Internet with friends when those aged 15 – 18 liked surfing the Internet alone and more younger children (12 – 15 years) used the Internet to search for information related to schoolwork than older ones (15 – 18 years) [97].

Children's Internet use at home is geographically stratified. Researchers have found differences in using the Internet between children living in urban and rural areas. In Greece, children in urban areas chose games for entertainment on the Internet more than those in rural areas. This may be because a higher percentage of children who lived in rural areas believed that the Internet had negative impact on their studying [97]. Children in urban areas were reported spending more time during weekdays on the Internet and interacted online more than their rural counterparts [96]. The correlation between children's place of residence and their online activities was observed to be significant. Similar findings were identified in New Zealand where the types of activities or applications appeared to have geographical alignment. For example, the use of music.ly was popular across one metropolitan area and not mentioned in other areas across the country [106].

Children in families with different socio-economic status also use the Internet at home in varying ways [20, 97]. Due to its cost, Internet access was more common in families with a higher income [19, 97] yet the biggest difference aligns with the education background of parents in the families. Children whose fathers or mothers have a higher education background reported using the Internet more at home than those in families where parents have a lower educational background [97]. [19, 97] yet the biggest difference aligns with the education background of parents in the families. Children whose fathers or mothers have a higher education background reported using the Internet more at home than those in families where parents have a lower educational background [97].

Gender, age, place of residence and socio-economic status influence children's online engagement. Parental involvement is another factor that has a strong influence on Internet access and use [79].

Parental involvement

Parents play an important role when children use the Internet at home [87]. Not only do they equip their children with technology and Internet access, but also monitor and support the use [70]. Parents are aware that the Internet can be beneficial for children and also has risks. Thus, they seek a balance between

maximizing children's digital opportunities while minimizing their exposure to online risks. Researchers have explored how parents perceive their children's use of the Internet as well as how they mediate their children's online behaviour.

We identified 24 studies discussing the involvement of parents in children's use of the Internet at home. Analysis of these articles identified four themes: parents' perceptions and attitudes, parenting styles and dimensions, parental mediation and impacts of parental involvement. Studies were conducted in different countries with the participants of parents, teachers or children aged from two to 19 (Table 4).

Table 4. Parental involvement in children's use of the Internet at home

Study	Year	Context	Participants (No.)	Age of children	Themes
Alshehri	2017	Saudi Arabia	Parents (43) Students (91)	16 - 18	Parents' perceptions
Álvarez	2013	Spain	Parents (711)	6 - 15	Parents' perceptions Parenting dimensions
Aslanidou	2008	Greek	Students (418)	12 - 18	Parental mediation
Zaman	2016	Belgium	Parents (24) Students (36)	3 - 9	Parental mediation
Chou	2016	Taiwan	Students (270)	12 - 18	Parenting styles
Davies	2011	UK	Students (262)	8 - 17	Parents' attitudes
Ihmeideh	2014	Jordan	Parents (570)	5 - 8	Parents' perceptions Parenting styles
Jesson	2015	New Zealand	Parents (40) Teachers (22) Students (40)	6 - 15	Parents' perceptions
Johnson	2009	Canada	Parents (128)	6 - 12	Parents' perceptions
Katz	2015	USA	Parents (1191)	6 - 13	Parental mediation
Khasawneh	2008	Jordan	Parents (127)	4 - 10	Parents' perceptions
Kirwil	2009	Europe	Parents (1949)	6 - 17	Parental mediation
Lei	2009	China	Students (1576)	13 - 15	Parents' impacts
Li	2013	China	Students (658)	10 - 14	Parents' impacts
Livingstone	2008	UK	Parents (906) Students (1151)	9 - 17	Parental mediation
Livingstone	2017	Europe	Parents (6400)	6 - 14	Parental mediation
Martínez de Morentin	2014	Spain	Students (1238)	14 - 19	Parental mediation
Nikken	2014	Holland	Parents (792)	2 - 12	Parental mediation
Oldham Smith	2008	USA	Parents (60)	5 - 18	Parents' perceptions
Özgür	2016	Turkey	Parents (23) Students (1289)	5 - 17	Parenting styles
Soh	2018	Malaysia	Students (1449)	15 - 17	Parental mediation
Valcke	2010	Belgium	Parents (533)	10 - 11	Parenting styles
Vitalaki	2012	Crete	Parents (1503)	9 - 11	Parents' perceptions Parents' attitudes
Wąsiński	2015	Poland	Students (368)	15 - 19	Parents' impacts

Parenting styles and dimensions

[Baumrind \[118\]](#) defined parenting style as various actions that parents take to control and socialize their children. In her initial theory, Baumrind identified three parenting styles including authoritarian, authoritative and permissive [\[119\]](#). Extending her work, Maccoby and Martin added neglected parenting style [\[120\]](#). These styles were based on two dimensions: parental warmth and parental control. Parental warmth involves communicating with children and support them in their use of the Internet, while parental control involves

providing children with guidance and rules on their online behaviour. On the basis of these two dimensions, [Valcke, Bonte \[87\]](#) described four parenting styles adapted from [Baumrind \[118\]](#) and [Maccoby and Martin \[120\]](#): Permissive, laissez-fair, authoritative and authoritarian.

- Permissive parenting style: Parents do not set up explicit boundaries and avoid confrontations with their children. They agree to children's requests and hardly give guidance.
- Laissez-fair parenting style: Parents have low levels of control and involvement in children's Internet use. They do not express supportive or restrictive attitudes towards their children's use of the Internet.
- Authoritative parenting style: Parents establish practical rules. Although they do not explicitly restrict children's behaviours, they impose high level of demand on children as being responsive or self-regulated.
- Authoritarian parenting style: Parents establish strict rules and expect children to obey those rules unconditionally. They hardly discuss Internet issues nor communicate with children about Internet access.

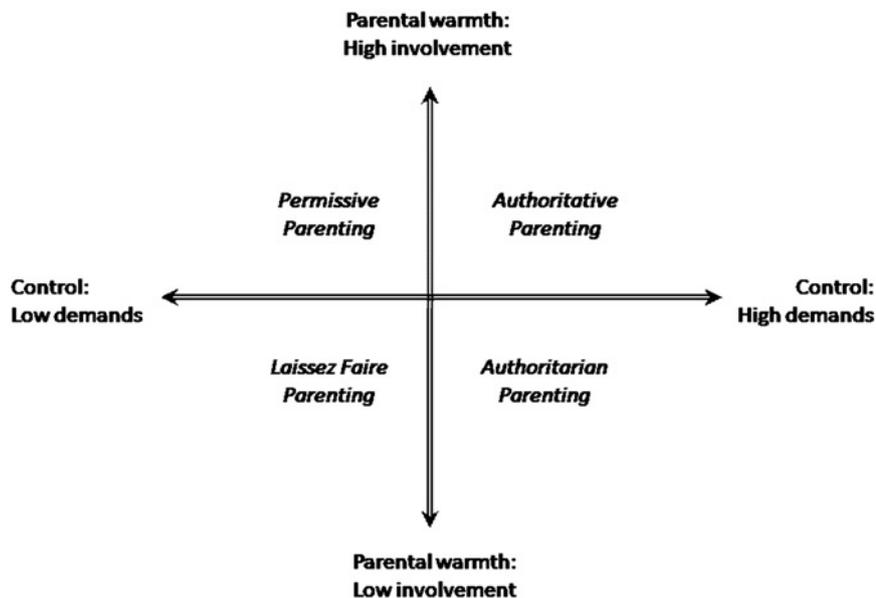


Figure 7. Parenting styles [87]

In Ihmeideh and Shawareb's study [113], these four styles were identified as permissive, neglectful, authoritative and authoritarian parenting styles. They were based on two aspects of parenting behaviours: parental responsiveness or warmth and parental demands or control (Figure 8).

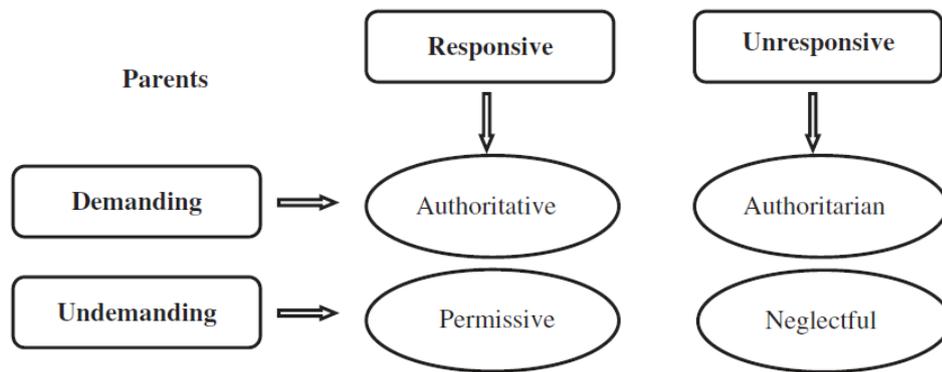


Figure 8: Parenting styles [113]

Parents have adopted different parenting styles in supervising their children’s Internet use at home. In Belgium, a study was conducted with 533 parents of children in the fifth or sixth grade to examine their Internet parenting styles. The researchers found that authoritative parenting styles was dominantly employed (59%), followed by permissive style (13%), authoritarian style (11%), and laissez-fair style (7%) [87]. The study also reported identifying a fifth, a mixed style in parents who reflected an average level of parental warmth and control. This showed a significant relationship between the two dimensions when “parents exerting a certain level of control, mostly adopt a warm relationship with their children, and vice versa.” [87]. [Ihmeideh and Shawareb \[113\]](#) found similar results in their study conducted in Jordan of 570 parents of 5-7 year old children. The most commonly practiced style was authoritative, followed by permissive, authoritarian, and neglectful was the least common parenting style [113]. The alignment between the two studies is interesting given they were conducted in differing contexts and with different aged children.

There can be a difference between parents’ perceived parenting styles and their children’s opinions about their parents’ styles. In Turkey, a study was conducted involving two phases. In the quantitative phase, 1289 students at five primary and secondary schools and six high schools were surveyed. Findings indicate that 46% of the students considered their parents’ Internet parenting style laissez-fair, 30% permissive, 22% authoritative and 13% authoritarian. This compared with parental perceptions of their parenting styles the most common was authoritative (55%), followed by permissive (30%) and authoritarian (15%) (Figure 9). No parents reported adopting a laissez-fair parenting style. Result from data with children of these parents showed that “the children's opinion on their parents' Internet style did not match with the Internet parenting styles that were found through interviews with the parents” [121].

Parental mediation

Parents use different strategies to mediate their children’s use of the Internet at home depending on their parenting styles. Researchers have conducted studies to explore what mediation practices are commonly used among parents. Strategies used for television viewing have been transferred to other media including children’s Internet use [122]. For example, active mediation involves communicating with children about the media content when they are using it. Restrictive mediation involves imposing some certain restriction rules on children’s use such as time, access, location or content, but not discussing with children about these rules. Co-using strategy refers to the presence of parents when their children use the media, parents and children spend time together using the media so that they can share their experience and perceptions [122]. Recent studies have expanded the range of mediation strategies that parents use in the home context.

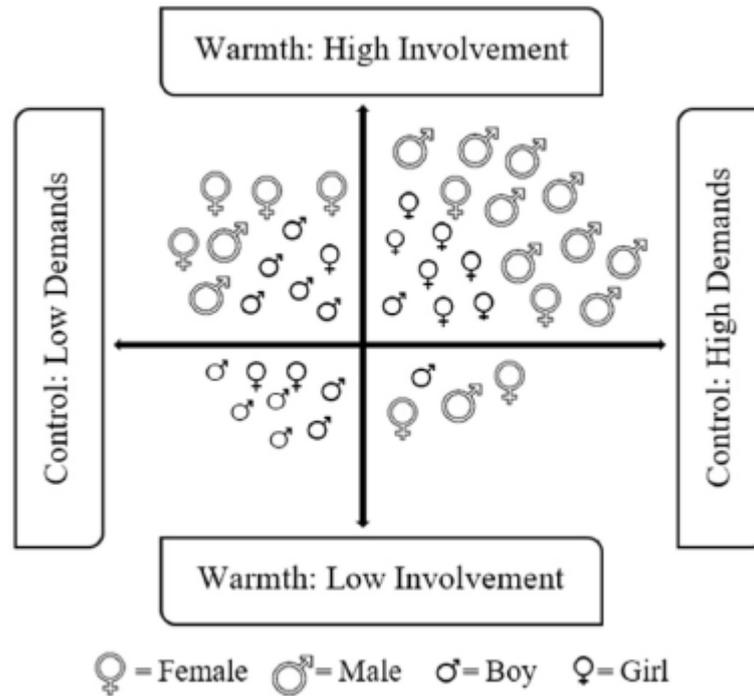


Figure 9. Comparison between Internet parenting style and child's opinion on parent's Internet parenting style [121].

Restrictive strategies have been a popular mediation option for parents with regards to managing their children's use of the Internet at home. This can be attributed to the perceived risks that children may encounter by being online. [Livingstone and Helsper \[122\]](#) found that parents in the UK implemented both interaction and technical restrictions by banning, filtering and blocking some certain online activities of their 12 to 17-year-old children such as email, chat, instant messaging, game playing and downloading. Similarly, [Kirwil \[123\]](#) reported that parents in 18 European countries used time and access restrictions to selected websites. This is similar to what [Nikken \[124\]](#) found in his study of Dutch parents of children aged 2 to 12. These parents set general rules on access (when and how long a child was allowed to go online) and content (what a child was permitted to do, visit, or download). These restrictions reflected the parents' vigilance of children's Internet use, especially older ones who were more susceptible to online dangers [124]. Together with content and time restrictions, [Zaman, Nouwen \[125\]](#) added three other types of restrictive mediation including devices, location and purchase restrictions. Those researchers found that parents of 3 to 9-year-old children in Belgium had concerns about setting changes or damage of devices, the safe place and position of using the Internet and the online purchases of things such as applications [125]. These studies have reported the use of anti-virus programmes, firewall or free-apps-only policies to avoid the negative effects from children's Internet use at home [122, 124].

Active mediation involves parents guiding children to be safe from contacting others through social media. Active strategies were used among parents with older children with interest in using social networks [124]. This was expanded in later research which reported that active mediation involves parents discussing with children about the content, time, devices and purchases. Parents engaged in discussing the moment or duration of Internet usage and the appropriate content with children so that they could negotiate or justify their mediation. Parents also taught their children how to manage technical issues like download or installation procedures, as they were aware of their children's lack of Internet experience. Additionally, parents were talking to children about what to buy in their use of the Internet [125].

Parents in European countries were reported enjoying sitting with children when they were using the Internet at home [123]. Dutch parents in Nikken's study preferred collaboratively surfing the Internet with children "to

track down pleasant content for mutual enjoyment” [124]. Parents’ intention was to not only reduce negative effects like children’s addiction but also enhance positive experiences to share with their children. This is consistent with what was found about parents in Belgium. Employing co-use strategies, parents played the role of a helper guiding “children when they used a digital medium for the first time or when they encountered problems” and a buddy “sharing certain media activities for recreational purposes” [125]. The study also indicated that buddy practices could come from “intentional actions (e.g., high parental involvement, family quality time) as well as routine and family practices (e.g., parent’s Facebook use or older siblings’ media preferences inciting new media opportunities or risks)” [125].

Participatory learning is a new style of mediation [125]. This strategy can be considered as a combination between active and co-use mediation as it involves characteristics of both strategies. In order to provide students with guidance or instructions, parents initially invest in their own knowledge and skills. Parents co-using the Internet with their children were engaging in conversations regarding online activities, evaluative comments or guidance. Active co-use mediation was used by 60% of parents in a UK study [122].

Monitoring and supervision mediation have been identified in studies. Livingstone and Helsper [122] found that 23% of parents monitored or checked up on their children’s online activities after use. Despite being recommended as a non-intrusive strategy, monitoring has been criticized of violating children’s privacy [122]. According to Nikken [124], parents did not adopt monitoring strategy with children at the young age, but they placed some technical constraints on their children’s web surfing. Instead, “supervision was the most common type of guidance for younger children” [124]. Parents reported giving their children some personal responsibilities for their Internet activities. This strategy was explained as the result of increasing concerns among parents about the negative effects of Internet usage [124]. A term of distant mediation was introduced as an umbrella term for supervision and deference by Zaman, Nouwen [125]. Parents with deference strategy grant children with autonomy in using the Internet, but maintain a certain level of involvement and keep informed from a distance. They chose not to intervene and give children trust and autonomy with an expectation that they used the Internet responsibly. Parents with supervision strategy allowed children to use the Internet independently while directly supervised them. They could possibly multitask with their household-related work but “remain within hearing distance to be able to easily switch back to their role of helper whenever necessary” [125]. Generally, parents have found ways to mediate their children’s use of the Internet at home. Different strategies could be applied to both reduce online risks and enhance learning opportunities for children. In a study conducted with 6,400 parents of children aged 6 in Europe, these strategies were grouped into restrictive mediation and enabling mediation [126].

The impact of parental involvement on children’s learning

How parents control and guide their children’s use of the Internet at home effects time spent online, attitudes and behaviours which can ultimately influence the educational value of the Internet at home. Parenting styles, involvement, mediation and support have been found to influence children’s Internet use, online risks and opportunities, home learning, computer self-efficacy and digital literacy (Table 5).

Parenting style influences children’s Internet use. When parents adopt an authoritative style, provide rules, discuss these rules with their children and encourage them to talk about their Internet usage, children have more exposure to the Internet at home without the pressure of being highly controlled or neglected [113]. This is consistent with research from China that reported 78% of middle school students had parental support and spent more time on the Internet than those without parental support [75]. However, in other contexts children in families with laissez-faire and permissive parents have been found to spend more time on the Internet daily [121]. Through an authoritative style parents influence how children spend their time online through mediation and guidance which increases the potential educative value of Internet use.

Table 5. Parental influences on children's use of the Internet and online learning

	Parenting styles	Parental involvement	Parental mediation	Parental support
Internet use	Ihmeideh and Shawareb [113] Özgür [121] Valcke, Bonte [87]	Aslanidou and Menexes [97]		Lei and Zhou [75]
Online risks	Chou, Chou [127]		Kirwil [123] Soh, Koay [114]	
Online opportunities		Şad, Özer [31]	Livingstone, Ólafsson [126]	
Home learning	Jesson, Meredith [95]	Alshehri [64]		Şad, Özer [31]
Computer and Internet self-efficacy				Lei and Zhou [75]
Digital literacy		Şad, Özer [31]		

Parents can reduce online risks and enhance online opportunities for their children. All strategies in parental mediation have found to reduce online risks for children although the effectiveness of each strategy depends on cultural factors [123]. For example, when parents set up restrictions on websites with inappropriate content they prevent children from being exposed to some online dangers [123] and when parents engaged in mediation activities their children's risky online activities and addiction behaviours significantly decreased [114]. Parental involvement also plays a significant role in opportunities through the Internet. For example, a study explored parental involvement into their children's education in Turkey. Providing children with different technologies including Internet access, parents were able to guide and mediate various online educational opportunities such as quick and easy access to information sources, improved digital literacy or social development [31]. Parents' involvement to mediate children's Internet use through an authoritative style not only reduces online risk but also increases opportunities for learning and development.

Children's Internet behaviour has been related to parenting styles. A laissez-fair parenting style has been found to influence children's Internet attitudes and Internet behaviours in Taiwanese indulgent parenting families [127]. These parents care about children's Internet use and do not set strict rules resulting in information-security risky behaviour when using the Internet. The study found that "students in the indulgent-parenting class who value the Internet more highly are more likely to exhibit secure Internet behaviour than students in the authoritative and neglecting-parenting classes" (p211). This confirms what [Valcke, Bonte \[87\]](#) concluded in his study that parenting styles made a difference to children's Internet usage.

Parents mediate children's use of the Internet to focus them on different forms of learning. In a New Zealand study, the involvement of parents was reflected in children's home learning. The parents reported not only "setting routines around homework, time on screen and the importance of a balance of after-school activities" but also "supervising, encouraging, checking, and sometimes assisting" [95]. They help their children benefit from learning through the Internet. This finding is consistent with the result in [Alshehri's](#) study who concluded that parents "have a mightily [sic] effect on encouraging their sons using Internet for homework and education purposes" [64]. By being involved in children's education through technologies, parents have brought about positive effects on their child's learning in five ways [31]. First, through supervising students' academic, personal or social development. Second, helping students improve their technology literacy. Third, providing visualized contexts to enhance learning and academic achievement. Fourth, developing student autonomy in learning and finally, by promoting children's artistic, intellectual, linguistic, and social development [31]. Parents' providing Internet access to students also resulted in some negative issues such as game addiction,

being distracted from studying or being exposed to inappropriate content. These impacts have reflected important role of parents' involvement in their children's use of the Internet for learning.

Parental support shows an association with children's outcomes. Children whose parents supported their use of the Internet could develop their self-efficacy. Parental support has been associated with children's technology self-efficacy, interest in technology, perceived importance of the Internet, and perceived impact of the Internet on learning [75]. Students in this study scored higher in computer and Internet self-efficacy measures.

Parental involvement has created significant impacts on children's use of the Internet in the home context. Parents use various strategies in different styles to mediate and moderate children's Internet use. They aim to minimize online risks that children may encounter and maximize opportunities. Parents' involving in children's online activities has benefit children's learning and development.

Cultural context

This section will discuss some impacts of the cultural context on the use of Internet at home. There is limited research exploring how home Internet use varies in different cultural contexts, but cultural factors are suggested having possible effects on children's Internet use. In this section, we examine how context influences children's Internet use and parents' styles of mediation from cultural perspectives.

Influence of cultural context on children's use

Children's use of the Internet may vary due to the influence of cultural contexts. Differences exist in the amount of time children spend online, the activities they engage in or their most favourite activities on the Internet. [Lei, Zhou \[99\]](#) conducted a study to compare Internet use between American and Chinese students. Certain cultural differences on Internet use were found. Although the time spent online of American and Chinese students was similar, the percentage of Chinese students spending less than one hour online at home was higher than that of American students. Whereas, the percentage of American students spending more than three hours on the Internet at home was greater than that of Chinese students [99]. The authors concluded that Chinese parents strictly control their children's Internet use at home by setting time limits while American parents had more concerns on online content than the time spent by their children [99]. This finding is similar to a study that compared the time spent on the Internet of American and South Korean students [39]. It is also consistent with a finding that "adolescents in Spain, Mexico and the Dominican Republic spend notably more time on the Internet than their counterparts from the other regions included in the study (Ireland, Bolivia and Chile)" [128]. Children in different cultural contexts spend their time differently on the Internet.

Contextual factors were also observed in children's purposes of using the Internet at home. For example, American students had a clear purpose of using the Internet. They mainly used it for learning at school and for entertainment or communication at home. This compared to Chinese students who used the Internet to play games both at school and at home. The authors concluded that this was due to the lack of guidance in how to use the Internet for learning purposes in the Chinese study and the language barrier when many educational resources online were in English. Additionally, American students used the Internet for diverse ranges of activities such as learning, entertainment, communication, and information seeking. Meanwhile, Chinese students tended to use the Internet mainly for communication and entertainment as ways of releasing pressure they experience at school [99]. However, this result is different from the conclusion of the study with participants from different cultural contexts including Spain, Dominican Republic, Mexico, Chile, Bolivia, and Ireland. This research found that the difference in Internet use purposes was minimal [128]. Cultural contexts may affect what activities children engage in when using the Internet at home.

For learning, students' Internet use varies in different cultural contexts. American students reported in the interviews that they used the Internet a lot for schoolwork assigned by teachers. They were required to access the Internet for searching more information to complete it. However, Chinese students reported that

technology was not integrated in their learning activities, so they rarely used it for learning. This has reflected the difference in educational cultures between two countries [99].

Contextual variation in parenting styles and mediation

Research has explored the role of contexts in parental mediation of Internet use among children. American students reported that their parents were supportive for their Internet use at home compared with Chinese students who reported that their parents set limits for their Internet use [99]. A study that explored how adolescents perceive parental mediation in their Internet use found that parents in different contexts adopted different strategies. Parents in Andalusia, the Basque Country, Aragon, and Dublin were not concerned what their children did online, so instructive mediation was rarely adopted, whereas co-viewing and instructive strategies were applied in South American areas of Cibao and Oruro [128]. This is consistent with a study with parents across Europe where parents in Spain and Italy combined enabling and restrictive strategies, Polish parents preferred enabling mediation and French parents went for restrictive mediation [126]. This implied that the cultural context shapes parental strategies.

Parents vary in their approach of mediating children's Internet use depending on their country and culture. [Duerager and Livingstone \[129\]](#) found that parents in Northern European countries such as Norway, Sweden, Denmark, Finland and the Netherlands adopted more active mediation strategies and less restrictive ones which compared with parents in countries such as Portugal, Spain, Greece, France, Germany and the UK who adopted high levels of both active and restrictive mediation. In terms of cultural differences, parental mediation was examined in four groups of European childrearing contexts including highly individualistic cultures of Nordic, Protestant countries, moderately individualistic cultures including Catholic countries and Greece, cultures of mixed values including European English-speaking countries and Belgium, and collectivistic cultures including post-communist/post-totalitarian-regime countries [123]. Some differences were found across these cultural contexts. In individualistic cultures parents engaged in activities of mediating their children's Internet use as children's socialisation were more important in these cultures than in collectivistic cultures. Although a social co-use strategy was popular in all cultures, parents in individualistic cultures used it more than those in collectivistic cultures. Parents in individualistic cultures provided their children with greater autonomy and self-direction. Parents in collectivistic cultures established restrictive rules on time of using the Internet more often than parents in individualistic cultures reflecting the values of obedience and respect from children [123]. These findings indicated that mediation strategies align with the cultural context of society.

Parenting styles are different between Asian and Western cultures, and perceived in different ways by the children within these cultures. For example, "Chinese students barely report authoritarian parenting style while Western adolescents consider this style as demanding" [127]. Children in Chinese culture are familiar with parental assertive involvement in both learning and non-learning related activities. Thus, children in Asian cultures do not differentiate between an authoritarian parenting style and an authoritative parenting style. This was identified in a study of high school-age students in Taiwan who perceived only three parenting styles including authoritative, indulgent and neglectful styles [127]. In this context, authoritative parenting style was the most popular type among parents as it proves to be the best one from a discipline perspective. When parents value education highly they help their children gain an advantage by restricting and monitoring their lifestyle, learning and safety [130].

Contextual factors influence children's use of the Internet at home and parents' styles of mediation. Children in different countries spend time on the Internet differently. They use the Internet for varying purposes at home, and how parents mediate their children's Internet use, varied across cultural contexts. The choice of style and mediation strategies reflects the values of the cultural contexts in which they are living.

The home context and educational value

Children use the Internet for a range of learning activities at home which are predominantly associated with accessing, presenting information, communicating, and skill development through gaming activities. Less often reported are creative uses such as developing digital objects or programming. The educational value of the learning activities at home is not clearly identified within the research literature due to the complexity of what is measured and how, however, children have been found to gain sense of agency and autonomy in learning. Parental involvement influences children's use of the Internet, with authoritative style and co-use conducive to positive use for learning and staying safe online. Parents in different contexts and cultures have adopted various strategies to mediate their children's online behaviors. Different parenting styles are related to what parents' value which is influenced by cultural context.

Home and school

When considering the alignment between technologies used at home and at school the complex relationship between what societies expects from young people in an emerging digital world and the desire to manage and protect those same young people from the adverse effects of being connectedness [81].

Five themes emerge from the literature that illustrate the multi-dimensional relationship between home and school interaction in the connected technologically enabled education setting. They are:

- **The Internet as the substrate technology**- those technologies enable ICT use but are not what the user interacts with routinely.
- **Technology for supporting school (formal) learning at home** – illustrates how the home-school context can be a complex relationship that can benefit from viewing with multiple lenses.
- **Application technologies** – the software assemblages' users interact with to achieve their desired outcome, this has a wider context than a single application
- **Technological synergy**, the outcome of the technology use is often greater than the sum of the technical artefacts involved.
- **Technological impacts** – any technology influences the communities the technology was designed to serve. The home-school relationship is no exception.

In the following sections, each of the themes is explained and examples drawn from the relevant literature.

The Internet as the substrate technology

Substrate technologies are those technologies that enable ICT use but are not what the user interacts with, the Internet being an easy example. We say we use the Internet but few of us ever interact with the Internet directly, rather we use an application enabled by the Internet, such as a web browser or email application. A substrate technology can change over time (better, faster, cheaper) but what we do on top of them does not necessarily change or at the same rate.

The Internet and the applications connect to it today have little in common with the incipient Internet that was used by a few technical enthusiasts and scientists in the 1980's (see Figure 1). Similarly, the Internet that the students of today use when they approach retirement will have evolved in ways we cannot yet imagine. Therefore, the challenge becomes how to equip the learners of today with the literacies and skills they need to make full use of the connected opportunities that they will arise whatever their futures bring?

[Zhao, Lu \[76\]](#) considered the challenge through the lens of technical artefacts; they explored how users expressed their autonomy in the context of home learning, the availability of social support, and how use varies with location, such as at school, home, Internet café and Internet self-efficacy. They found links between Internet self-efficacy and home Internet, social support and exploratory behaviours. Supporting the value of having reliable Internet connectivity as being a potentially positive attribute for home and school.

The increase in access to the Internet in OECD countries has led to the claim that “*most students now have access to the Internet...*” [102] although some students may have constrained access or access only through school. However, access does not provide equity in terms of educational value from the use of Internet capable devices. This is supported by a recent study that reports on an eLearning pilot in Hong Kong schools [131] that found that devices (shared and exclusive) have reached ubiquity in home and school context for the schools and that the focus needs to shift to understanding the efficacy of the eLearning rather than on substrate issues.

In New Zealand, [Grimes and Townsend \[132\]](#) examined broadband in schools (not homes) using a narrow economic performance lens and observed NCEA pass rates and found no evidence to support that fibre broadband investment had resulted in an increase in performance in NCEA but that fibre broadband did result in primary level (national standards) pass rates increasing.

A similar exploration by [Fairlie and Robinson \[8\]](#) of students in California (an experimental correlation study) linked computer ownership with performance in standardised tests. They found that Internet connected home computer ownership and use did not materially affect performance or had any effects on educational outcomes, grades, test scores, or attendance and discipline. Their conclusion was that while a lack of access to computing at home may appear concerning, it did not necessarily limit academic achievement. A contrasting example comes from [Casey, Layte \[38\]](#) who used Irish longitudinal (Growing Up in Ireland) data to conclude that reading and mathematics performance scores of nine-year olds was improved by Internet connected home computer access (with a variety of applications within that frame).

A broad-based approach in a UK study sought to explicate the tension between discourse of digitally well-informed youth and the need to provide a controlled environment for learning [81]. They observed that the youth in their study report that the Internet enabled them to take ownership of their learning, maintain social ties, access entertainment and express autonomy in the learning locations and modes.

The Internet substrate can be considered by the type of devices that are used to connect to and through the Internet. For example, students with access to desktop computers at school or home have a different experience than those with access to mobile devices or cyber-cafes [43]. [Sampath Kumar and Basavaraja \[92\]](#) study of rural Indian students found that the use of Internet-connected computers at home was dependent on support of teachers and also students and families. If any one of those three were missing, continued usage would be difficult to sustain.

These examples point to the Internet in 2018 as a useful educational substrate that does what it is designed to do in that it is not a solution to anything in and of itself but rather forms the foundation onto which useful sociotechnical artefacts can be added to build the home-school Internet-connected learning context.

Technology for supporting school (formal) learning at home

The school has a role to play in assisting students and their families to use the technology that is available to them in a way that fosters effective learning. [Furlong and Davies \[33\]](#) instigated an interesting discussion of ways of learning and the interplay between home and school contexts, “trying to take the home seriously as a distinctive context in which to understand learning with ICTs” (p.59). In this sense, the teacher is like a broker for good learning practices that can be taught at school and utilised at home or in a different learning context. [Jewitt and Parashar \[37\]](#) review of the BECTA pilot of home access met its programme objectives, albeit unevenly, and accelerated access for families that previously had no or insufficient access. They also concluded that the home access had stimulated new learning conversations involving digital work between parents, students and teachers forging new links between home and school via digital channels. Unfortunately, the BECTA pilot was not followed through because of a shifting political focus that closed the BECTA agency in 2011. [Gurung and Rutledge \[105\]](#) explored the balance of personal and educational digital engagement situated in terms of the learning ecology that includes home and school. The studies in this review suggest that the relationship between the student and the effective use of Internet enabled devices and communications for learning is moderated by parents/whānau and the school/teacher dyad (Figure 10). This model illustrates

the serial moderating influence the parent/whānau and school/teacher has in the relationship between the student and their use of the Internet. This is not a simple deterministic one-way dependent- variable type of relationship, the student defines the Internet in their context as a social construction and the Internet creates a flow of communication and information in return. Both the student and the affordances the internet provides can have an enabling or controlling effect on the students learning.

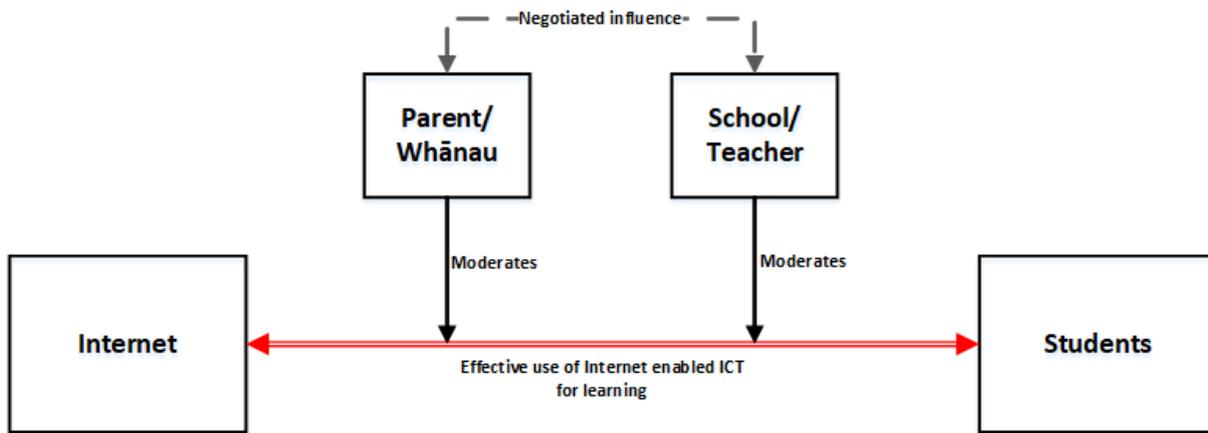


Figure 10. Moderating influences of students' Internet enabled learning at home.

The alignment between home and school learning can involve learning curriculum-based knowledge and digital competencies. A study relevant from the New Zealand context focused on literacy and mathematical curriculum-based knowledge and concluded that there is “...no need for learning to be divided up between home and school...students can access learning activities via the class site...” [15]. However, the authors note that there is a need for teachers to set cognitively demanding homework and to teach students how to learn digitally. They summarised it as: “...for those students engaged in some of the more cognitively challenging activities, digital learning strategies were key to their success, and unsurprisingly, there was variation between students in strategies they reported using, for example, in managing distractions, searching, finding information, and collaborating...” (p.40). The development of digital competencies can be measured through tools such as a 32-item Internet-savviness scale which draws upon Vygotsky’s zones of proximal development to explore how youth develop Internet related skills [57]. Similar access, digital devices and activities are needed to maintain alignment between home and school learning.

Application technologies

While the Internet substrate will continue to evolve as mobile networks become faster, cheaper and more reliable the uses to which students put the communications and learning applications will continue to evolve in lock step with the Internet. Johnson [74] used a techno-ecological subsystem viewpoint to explore children’s use of messaging (both synchronous and asynchronous) and explored how those applications were used to enable and increase social skills. In a follow-up study she noted that Internet use by children happens in three contextual settings of home, school and in the community [41], however, these three contextual settings may blend over time. Likewise, the boundaries between what is an application, a game or a communication tool becomes blurred when different attributes such as communications are embedded in games, websites or learning applications. For example, it is challenging to categorise a particular application or activity as purely one thing or another. Overall, Johnson observed that school-based Internet use increased reading achievement measurably and home-based use did have an effect but noticeably less.

In contrast, the story is not always about success, Areepattamanni [133] also found a positive relationship between ICT use at home and social communication. They went on to express the need for caution and highlighted the need to manage for maladaptive situations where children of different ages need age-

appropriate controls in place to moderate access to inappropriate or harmful content or interactions. This can also be a more complex issue when siblings of different ages share technology, for example, do parents and schools moderate access for the lowest age in the household?

The introduction of the Internet has revolutionised communication between home and school. Parents and teachers can communicate through a range of application technologies including email or web apps and parents can follow events and news through school online interfaces. Parents can access information about their child's educational progress through student management systems, student blogs or portfolio applications such as Seesaw. This development of school-home communication plays a role in building and maintaining parental involvement in education [134]. However, this can only work when the parents have access to the Internet and are digitally literate and the school has systems in place to enable this to happen.

Technological synergy

The outcome of technology use is often greater than the sum of the parts of the technical artefacts involved. Students, teachers and communities incorporate digital technologies in ways that the designers could not foresee. At times this is helpful and empowering but that outcome is not guaranteed. [Baytak, Tarman \[94\]](#) took a phenomenological approach to understanding a group of students using technology at school for 'business' style applications and a technology club for 'design' application in order to understand how schools can setup approaches that can be used to enrich students' learning at school and at home, finding that students had common perceptions of their experiences. Cultural, social and economic mediation in students' activities with digital devices tended towards homogenizing the adoption of applications resulting in less breadth than the broad brush that the overused "digital natives" term implies [117]. In [Hatlevik and Christophersen \[135\]](#) study of Norwegian senior secondary students' digital competence, it was emphasised that digital competence is far from homogenous and the reasons for some are varied both culturally and in geographical contexts. This identifies a possible gap between the dominant discourse of contemporary youth as universally technically competent and the groups of young people who have shallow knowledge of using technology for their learning either by choice or through lack of opportunity. This calls for deeper research into what students' ICT use really consists of and what that means for education in general. This idea is further reinforced by [Katz, Moran \[136\]](#) who considered the contextual setting of technology in the home and family as a set of factors that influence digital equity.

Technological impacts

Any technology influences the communities the technology was designed to serve. The home-school relationship is no exception. [Hatlevik and Christophersen \[135\]](#) observed that the impact of language integration and cultural capital at home had a significant impact on being digitally capable at school and in general. This is also borne out by [Hartnett \[90\]](#) study of students' in New Zealand and their impressions of their schools and teachers use of technology to support learning influenced home use. This influence is not limited to OECD countries; in a developing context such as rural India adequate support from teachers and families was found to be essential. [Sampath Kumar and Basavaraja \[92\]](#) study in rural India found low uptake of computing despite 94% willingness to use computing. Student wanted access to computing but lacked the school and parental leadership to achieve that goal.

Overuse is a technological theme in the literature that impacts on the communities it is designed to serve. The PISA 2015 (Vol III) report cites students' well-being as a significant factor in the use of digital technology [102]. The report observes that more than six hours of weekday use outside of school was likely to result in students reporting diminished life satisfaction, increased feelings of loneliness, and reduced performance in science subjects. This was reinforced by [Gronn, Scott \[137\]](#)'s discussion of [Levin and Arafeh \[138\]](#)'s 'digital disconnect' in the home-school dyad. This analysis of the non-binary flow of practices by young people across contexts that makes the situational labels of 'school' and 'home' problematic.

Equitable digital access to the Internet beyond school: A literature review

In summary, managing the relationship of students with the affordances offered to them through having high-quality access to the internet at school, at home and those spaces in between is a non-trivial task. The internet substrate and what runs on top of it will continue to evolve. The task then becomes how to identify and realise the benefits of using applications in ways that support how students want and need to learn in the third decade of the 21st century and beyond. Instead of sticking to tight boundaries such as 'formal' or 'informal' learning, educators and planners will need to understand how to address increasing complexity, choice and modes of learning that suit individual needs. They will do this by recognising that assemblages of tools, applications, and techniques will be constantly evolving and changing. Embracing those changes and pulling together approaches in new ways that takes advantage of the synergies will be the opportunity to be exploited. As understanding of the technology mediated home-school relationship matures the technologies, themselves will adapt and change to suit.

Summary

Policy interventions that have provided Internet access to the home of school aged children have been with the intention of closing digital divides within or between communities. The interventions identified have provided access to the Internet and digital devices in the child's home with the explicit aim of developing children's digital capabilities, motivation to learn, academic achievement, parental engagement in their child's education, and/or to enable student-centred pedagogies. While not all initiatives have evaluations available, the ones that were have mixed results. Digital inclusion has four aspects: access, motivation, capability and trust. The interventions identified in this review focused on developing access and capability, which align with early notions of digital divides. Developing participatory digital citizenship for those on the wrong side of the divide has yet to be identified as a focus in policy interventions.

Through the process of identifying and analysing research literature, a lag in available evidence was identified. Between about 2000 and 2015 policy initiatives aimed at bridging digital divides primarily focused on providing access to hardware, or digital devices such as desk-top computers or laptops, with some also including access to the Internet beyond school buildings. More recent initiatives, which focus on Wi-Fi or Mobile access, are not yet published widely. Further constraining factors on the availability of publications associated with Internet initiatives is the lack of publications when particular initiatives are withdrawn or the results are considered not noteworthy because of a perceived lack of impact. This imbalance in the available literature can be addressed by encouraging more research that looks into, and explains what success looks like and examines why other initiatives are not. For example, an analysis of New Zealand virtual learning network (VLN) clusters in 2016 considered why some clusters succeeded while others struggled [139]. Similar logic can be applied to examining school and home internet provision.

Studies that specifically measured the educational value of home Internet access were located and analysed. Through this process three areas of educational value were identified; the learning, psychological and social domains. The studies that measured learning included 68 studies that reported a positive learning outcome, six reported a negative outcome (half of these were in the area of literacy) and four reported neutral outcomes. In the psychological domain, 22 studies reported positive outcomes from home Internet access, three reported negative and three were neutral. In the social domain 13 were positive and one was negative. It can therefore be concluded that home Internet access has a positive impact on student learning, psychological development and social aspects, but not always. The conditions that influence the educational value include aspects in the home context and the home-school alignment.

In the home context, a recurring theme is that children are reported using the Internet for different purposes. Children's Internet use at home is influenced by different factors including gender, age, cultural context and socio-economic status of their families. Children of parents with lower education levels, fewer technical skills and in low socio-economic households tend to have less positive outcomes Internet use at home compared to their peers with greater cultural capital. This suggests that providing the Internet into the home will not close a digital divide without interventions that counteract the contextual disadvantage such as providing access to technical and academic support for the students (which may be through the parents for younger children). However, it should be noted that children in low socio-economic communities have been found to develop a strong sense of autonomy and agency which may be attributed to the home context where they may be experts in the academic and technical expectations of learning at home through the Internet.

Internet access offers children a range of activities for entertainment such as playing games, watching movies or listening to music and ways to communicate and collaborate with others through social media and communication technology. How this is used varies according to the age of the child and gender and parental mediation. Children who are gaming during the week have been found to do less well academically and children who spend little time on the Internet are also disadvantaged with a lack of digital literacy, therefore parental mediation of use is important. Parents adopt different styles with varying mediation strategies that

Equitable digital access to the Internet beyond school: A literature review

influence children's learning opportunities and online risk. The style adopted is influenced by the cultural context of the family. An authoritative style and co-using strategies has a positive effect on children's learning through the Internet at home and a laissez-fair style can reduce children's risky behaviours online.

Children also use the Internet for different forms of learning at home. The Internet is most commonly used for accessing, presenting information, communicating, and skill development through gaming activities. Although the educational value of these online activities have not been clearly identified, there is a risk that the students in low socio-economic communities are given less cognitively challenging activities than their more wealthy peers, which will further widen an educational value gap. There was little evidence of students learning how to participate in social, economic or political digital contexts to empower their position in society and reduce future digital divides. However, it may be that this type of research was not associated with home Internet access and instead is taught within schools, therefore not identified through this review.

Conclusion

Internationally, policy interventions to date have focused on the provision of devices and home Internet access as a means of addressing digital divides for children in low socioeconomic communities. These interventions have also often gone hand-in-hand with a focus on integration of digital tools into teaching practice and/or support for parents to moderate their children's Internet use appropriately to encourage use and skill development. Evidence of learning gains attributable to particular policy interventions are less frequently encountered. Where there is evidence, it seems to point to skills, attitudinal and motivational gains rather than increases in test scores in academic learning domains.

This literature review identified research that directly explored the educational value of home Internet access. Internet access in the home is related to positive outcomes for children's learning, psychological development, social skills and parental engagement in their child's education. However, the potential educational outcomes cannot be separated from the context in which learning occurs. Children's use of the Internet, parental style, family socio-economic context, and the alignment between home and school are each related to the educational value of home Internet access.

Recommendations.

The following recommendations are designed to provide the conditions identified in the research literature which are likely to maximise the educational value of home Internet access for students in low socio-economic communities that were:

1. Children in low socio-economic communities have access to the Internet at home and a digital device for learning
2. Teachers are supported to use the affordances of the Internet for educational purposes, including providing appropriate cognitively challenging online learning activities, developing children's digital competencies for learning and autonomy
3. Children's formal learning at home is aligned with their learning at school
4. Parents receive advice and guidance on how they can support their children's online activities to maximise the educational value of the Internet at home. Such advice should be sensitive and appropriate to cultural context and include information about parental mediation research and child safety online
5. Children have access to technical and academic support for learning at home
6. Further research and analysis be undertaken to evaluate online learning activities at home to identify high impact uses that maximise cognitive, social, psychological, and participatory benefits of home Internet use. The findings to be shared with teachers to inform practice.

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Appendices

Appendix 1. Summary of reviewed literature.

First author - Year	Context	Methodology and focus	Findings and link to document
Acar Güvendir 2017	Turkey 15 year old students	Correlational research model using PISA database The relationship between home and school educational resources and students' mathematical literacy	Having an Internet connection at home found to have little connection with students' mathematical literacy. An Internet connection at school is negatively related to students' mathematical literacy. DOI: 10.17860/mersinefd.305762
Agić 2016	Bosnia High school students	Student questionnaires and students' average scores The relations between socio-economic conditions in which students live and the success of students in learning.	There are relations between the determinants: completeness of the family, number of family members, education level of parents, time invested in learning, choice of the school, whether they have Internet access at home, and finally average grade that a student achieves. DOI: 10.17810/2015.31
Akyol 2010	Turkey Seventh-grade students	Survey using questionnaires and T-test The relationships between students' background characteristics (gender, prior knowledge, socioeconomic status) and their cognitive and metacognitive strategy use and science achievement.	The relationships between students' background characteristics (gender, prior knowledge, socioeconomic status) and their cognitive and metacognitive strategy use and science achievement. Elaboration, organization, and metacognitive self-regulation strategy use were found to make a significant contribution to students' science achievement. DOI: 10.1080/13803611003672348
Ali 2016	New Zealand Secondary school clusters.	Qualitative study The factors that have supported the development of a self-sustaining virtual cluster of secondary schools.	A number of key features were concluded as the required conditions or principles for the development of self-sustaining clusters. To extend the research discussion, a complementary lens of Complexity Theory was utilized and some key principles of complex adaptive systems were used in assessing the research outcome and thus establishing further credibility of the ANT-based research findings. http://dx.doi.org/10063/6457
Alshehri 2017	Saudi Arabia	The descriptive method of quantitative and qualitative	The internet usages have promising consequences on the homework completion and students' performance.

	High school students Parents and teachers	The usage, the effectiveness and perceptions of using Internet for homework completion and submission.	There were some unpersuaded participants towards the benefits of internet usages on students' growth. https://eric.ed.gov/?id=EJ1143921
Anastasiades 2008	Greece and Cyprus Students aged 11 – 12 and their parents	Questionnaires The impact of the implementation of a new collaborative learning project at a distance via videoconferencing in elementary schools on families. The level of parental involvement with their children as reflected in shared educational and interpersonal digital activities.	Parents respond to the “newness” of digital collaborative learning and interpersonal activities of their children according to their level of use and perceived compatibility of the information and communication technologies. https://doi.org/10.1016/j.compedu.2007.02.003
Anderson 2018	USA Children aged 13 - 17	Survey The use of social media among teenagers	Facebook is no longer the dominant online platform among teens. Teens have mixed views on the impact of social media on their lives. Vast majority of teens have access to a home computer or smartphone. A growing share of teens describe their internet use as near-constant. A majority of both boys and girls play video games, but gaming is nearly universal for boys. http://www.pewinternet.org/2018/05/31/teens-social-media-technology-2018/
Araque 2013	USA “COMPUTERS FOR FAMILIES” Residents in a low-income, urban community.	Quantitative and qualitative method with instruments such as focus groups, pre-tests and post-tests, questionnaires for self-reported surveys. The effects of home computer access on low-income families participating in the Computer for Families program.	Participants in the Computers for Families program were more likely than non-participants to have access to the Internet from home, use a computer for more than 1 h per day, complete online job applications, and submit job applications and resumes electronically. https://doi.org/10.1016/j.chb.2013.01.032
Areepattamannil 2017	Adolescents in 20 countries with mean age: 14.35 years	Data from Computer and Information Literacy Study (ICILS) 2013.	Early adolescents’ ICT-related behavioral and motivational characteristics significantly and positively predicted their use of ICT for social communication.

		The predictive effects of ICT-related behavioral and motivational characteristics on the frequency of use of ICT for social communication among early adolescents.	Internet access at home, number of computers at home, learning of ICT tasks at school, use of specific ICT applications, use of ICT during lessons at school, use of ICT for recreation, ICT self-efficacy, and interest as well as enjoyment in using ICT significantly and positively predicted the use of ICT for social communication among early adolescents in 20 countries. https://doi.org/10.1016/j.chb.2017.03.058
Aslanidou 2008	Greece Student aged 12–18	Structure self-reported questionnaires The relationship between Greek young people aged 12–18 and the Internet through their patterns of Internet use in the home. (the possible effects of social stratification, gender and age on their domestic Internet use.)	Internet access remains at a low level. There was a correlation between the Internet and age, socio-economic identity, gender. School plays an important role in the relation of young people to the Internet. There is a lack of parents' presence in the relation of youth to the Internet as they do not know how to use it. https://doi.org/10.1016/j.compedu.2007.12.003
Asselin 2010	Canada Two participants (male aged 15, female aged 12)	Quantitative and qualitative. The Internet literacy practices of adolescents during homework tasks	Internet was not necessarily required by the assignment but rather a choice by the students. Learning processes are much less tangible dimension than searching and analysing information. Students monitored their comprehension of the information they had found. https://doi-org.helicon.vuw.ac.nz/10.1080/17437271003597923
Balanskat 2013	Europe Students in primary and/or secondary education.	Survey Factors for successful implementation of 1:1 initiatives, and presenting policy options that successfully promote technological, pedagogical and organisational innovation in Education and Training (E&T).	Overall, evaluation reports from 1:1 initiatives provide evidence of impact on motivation; student centred learning; teaching and learning practices; learning outcomes; and parents' attitudes. For instance, almost all the evaluation reports refer to students being more motivated when using the given devices. According to some of the reports the motivation could be maintained longer term when devices were regularly used; when students were able to work and do exercises independently with learning software giving them immediate feedback; when students had the possibility of carrying out research on the Internet, presenting the results of their work, and exchanging more easily with other students.

			http://ideas.repec.org/p/ipt/iptwpa/jrc81903.html
Baytax 2011	USA Elementary and middle school children	A phenomenological study using in-depth interviews, classroom observations, and home observations. The experiences of children using technologies in their education.	Students have common perceptions toward their experience with technology integration. The educational value that the students gave to technology was more about the motivational factors, sense of convenience and independent use. Most parents thought that their children were not doing anything educational on the computers. Teachers thought that home computer use was still not under their control to give educational tasks for students to do. https://eric.ed.gov/?id=EJ1052441
Berkowitz 2015	US, First grade students	A randomized field experiment The relationship between increasing maths activities at home and children's math achievement at school	The intervention, short numerical story problems delivered through an iPad app, significantly increased children's maths achievement across the school year compared to a reading (control) group, especially for children whose parents are habitually anxious about maths. DOI: 10.1126/science.aac7427
Beuermann 2012	Peru "One Laptop per Child programme" Primary school children	Surveys and administrative data from the Ministry of Education of Peru. The effects of expanding home computer access in a developing country	The programme helped increase students' exposure to computers and their use of computers at home. Students used computers to complete domestic chores rather than reading books. There was no evidence of students' improvements in skills related to using a computer or Internet. http://dx.doi.org/10.1257/app.20130267
Beuermann 2015	Peru "One Laptop per Child programme" Primary school children	Surveys and administrative data from the Ministry of Education of Peru. The short-term impacts of expanding home computer access in a developing country	The intervention increased access and use of home computers, with some substitution away from computer use outside the home. Children randomized to receive laptops scored about 0.8 standard deviations higher in a test of XO proficiency but showed lower academic effort as reported by teachers. There were no impacts on academic achievement or cognitive skills as measured by the Raven's Progressive Matrices test. Finally, there was little evidence for spillovers within schools. DOI: 10.1257/app.20130267
Bonne 2015	New Zealand	Focus group interview	One of the case studies included creating an online environment where examples of te reo Māori (written, sound, and video files) can be shared,

	Professional development initiatives to build school-whanau engagement.	What can teachers and school leaders in English-medium schools do to include whānau aspirations and strengthen whānau engagement in Māori students' learning and wellbeing?	questions asked and concerns raised, with supportive ideas provided as needed. Students and their whānau also contribute content to the site. This initiative created a virtual space for engaging whānau with a focus on their children learning te reo Māori. http://dx.doi.org/10.18296/set.0024
Brunton 2015	New Zealand Children aged 6 - 14	Survey Understanding of updated changes in New Zealand children's media behaviour	On demand sites (NZ and international) are rarely used by 6-14 year olds on a daily basis. Radio reaches one in three children each day, and The Edge continues to be the most popular radio station, especially among 12-14 year olds. Age is the biggest differentiator of media behaviour and usage evolves and grows as children get older. There is a key 'tipping point' at 11 when YouTube and Facebook use increases significantly. Generally, boys are bigger consumers of the internet, YouTube, cartoons on TV, and gaming, than girls. Girls are bigger consumers of music and radio, and older girls (12-14) are bigger consumers of TV2. There are ethnic group differences in media access and use. Māori and Pacific children, for example, are less likely than average to watch YouTube and play games online, and they are less likely than Asian children to use a tablet. Māori children are also less likely than Pakeha children to use a PC or laptop. Parents are the key online content decision-makers for most children until the age of eight. https://bsa.govt.nz/images/assets/Research/Childrens_Media_Report_2015_FINAL_for_publishing_2.pdf
Cabiness 2013	USA Six 7 th grade students	Participant posts on each wiki page (Wiki Statistics (an internal tracking system)), student responses and Screenshots. The impact of collaborative Web-based learning on student acquisition and practice of historical analysis skills	Students, when given the option, chose to use higher order thinking skills. The high number of responses by the RSP students was a surprising outcome. The data indicates that wikis foster collaborative learning, interaction, and natural student inquiry. https://doi.org/10.1007/s11528-013-0700-y

Casey 2012	Ireland 9 year-ole children	Survey with questionnaires The link between children's home computing and their academic performance in the areas of reading and mathematics.	Searching for information is a more popular activity among the children than communicating online. Using a computer is positively and significantly associated with children's reading and mathematics scores in standardised tests. Some forms of early computer use have significant associations with academic performance among children in primary school, although we could not establish the direction of causation definitively. https://doi.org/10.1080/03054985.2012.731207
Chen 2018	Singapore 10 – 15 year-old children	A large-scale survey The norm of Singaporean students' new media literacy	Students with higher SES scored higher on the four types of new media literacy. Students from families with more computers and hand phones tend to have relatively higher scores on the four types of new media literacy. DOI: 10.1016/j.compedu.2018.04.010
Cheung 2013	Hong Kong and Korea. 15 year old students.	Using data collected in the PISA 2009 The mediating variables that explain the gender difference in digital reading literacy between Hong Kong and Korea.	The present study confirms that for both Hong Kong and Korea, ICT use at school and ICT use at home for schoolwork cannot account for the narrowing of the digital reading gender gap. https://doi.org/10.1007/s40299-013-0077-x
Chou 2016	Taiwan Secondary student	Questionnaires Ways parenting styles moderate the relation between the Internet attitudes and behaviours of high-school-aged students in Taiwan.	Internet attitudes are statistically significant in predicting online social compensation and game addiction across the parenting classes, whereas attitudes are only statistically significant in predicting information security behaviour in the indulgent- parenting class. http://dx.doi.org/10.1016/j.compedu.2015.11.017
Crothers 2015	New Zealand People aged 16+	Telephone and online survey The Internet use	The sample divides into five usage categories: never-users (5% of sample), ex-users (3%), low level users (11%), first generation users (9%) and next generation users (71%). Most internet users say they surf or browse the web (95%) or visit social networking sites (85%). Some 49% of users now report that they use the cloud, up 15% on 2013. Nearly half of respondents (45%) agree that there is no such thing as privacy online, and they accept that situation. Being a former user is directly related to economic factors. https://workresearch.aut.ac.nz/data/assets/pdf_file/0003/71328/WIPNZ-Report-060515.pdf

Davies 2011	UK Young people aged 8 – 17+	A mixed method study The ways in which parents try to balance the sometimes contradictory roles of being both technology providers and technology regulators, and the ways in which young people act in response	While parents inevitably experience a gradual loss of control over their children's uses of technology as they enter the later years of adolescence, findings show that although some young people develop highly autonomous and innovative uses of technology for learning, many others come to moderate their uses of technology in ways that are acceptable to their parents. DOI: 10.1111/j.1365-2729.2011.00427.x
Di Blas 2013	Italy Students aged between 5 and 18	Online surveys, focus groups, Skype interviews The PoliCultura, (the PoliCultura initiative's description, selected examples, Some data on the evaluation then the conclusions)	PoliCultura shows that it is possible to bring innovation in a conservative environment like the school, blending formal and informal education while promoting out-of-the-classroom activities. Data show that in doing so students achieve substantial educational benefits, many of which specifically related to this approach: the vast majority of participants involved other subjects like families, cultural institutions, museums, local associations of various kinds, local tourist bureaus, politicians, experts of various subjects, book writers, and even old immigrants. Students roamed the territory using various kinds of devices, like their cell phones or digital cameras, to gather content that was then refined in the classroom. https://www-jstor-org.helicon.vuw.ac.nz/stable/jeductechsoci.16.1.15
Dodson 2014	USA Junior and senior level students	Homework completion rates, homework grades, class participation, and final, quarterly grades. Whether online homework creates a measurable difference in student performance when compared to traditional, paper homework.	Both classes have nearly equal rates of completion and grades in their homework, but there is a clear difference in participation and final grades. Increased student performance when utilizing paper homework may give support to explaining why most teachers still utilize this method. Online homework classroom had nearly the same homework grades and a significantly higher overall grade. http://www.icaseonline.net/sei/december2014/p1.pdf
Drabowicz 2016	Germany & Norway 15 year-old students	Using data from the 2012 PISA project. The differences in patterns of Information and Communication Technologies usage among fifteen- year olds and the factors structuring those differences.	In both countries gender, migration background, family structure, the parents' level of education, material access to the Internet at home, and the number of books at home may cause notable differences in digital usage. https://doi.org/10.1016/j.compedu.2016.10.004

Duarte 2013	Brazil Ninth grade students, teachers, and school directors	Questionnaires Information relevant for the formulation of new policies for the integration of technology in education	The use of a computer at school positively affects the frequency of use and suggests that schools can play a role in promoting digital inclusion. The availability of media resources at home, how long students have been using a computer and cultural practices during the students' free time had notable positive correlations with the student's abilities. https://epaa.asu.edu/ojs/article/view/1241
Duerager 2012	Europe 9-16 year children	Online survey Whether, instead of imposing restrictions, parents can support their child's internet safety by sharing a positive experience of internet use with them.	Restrictive mediation reduces online risks, but it also reduces their online opportunities and skills. The new analysis in this report shows that when parents actively mediate their child's internet use, this too is associated with lower risk and, most important, lower harm. However, parental active mediation of use is linked to more (not fewer) online activities and skills. http://eprints.lse.ac.uk/id/eprint/42872
Erdogdu 2015	Turkey, France, Germany, and UK. 15 year-ole students	Quantitative study using data from PISA 2012 The impact of access to ICT, student background and school/home environment on academic performance of students.	Availability of internet connection at home or school and student's possession of his/her own room at home have positive impacts on academic success internet connection at schools may not be used for school-related activities and therefore distracts student's attention from schoolwork There is a positive relationship between education level of parents and student's performance at school. https://doi.org/10.1016/j.compedu.2014.10.023
Eynon 2009	Britain Children aged 14+	Survey with data from the 2003, 2005 and 2007 OxIS, carried out by the Oxford Internet Institute, University of Oxford the digital divide in relation to learning activities online.	Home access is not significant for using the internet for training and other formal learning activities. Broadband connectivity at home is significantly related to whether people carry out learning activities online. DOI: 10.1080/17439880903345874
Fairlie 2013	US Grade 6-10 students	Experimental designed study Whether access to a computer at home influences outcomes.	No effect on any educational outcomes, including grades, test scores, credits earned, attendance, and disciplinary actions. Our estimates are precise enough to rule out even modestly-sized positive or negative impacts. The estimated null effect is consistent with survey evidence showing no change in homework time or other "intermediate" inputs in education. DOI: 10.1257/app.5.3.211
Foss 2013	USA Adolescents aged 14-17	In-context interviews and observations How adolescents search on the Internet in their homes to provide	Evidence that adolescents are social in their computer use, have a greater knowledge of sources than younger children, and that adolescents are less frustrated by searching tasks than younger children. DOI: 10.1002/asi.22809

		key adult stakeholders with ideas for improving adolescent search skills.	
Furlong 2012	UK Young people (aged 8–21)	A large-scale mixed method The ways in which the young people engaged with new technologies in their lives—in all of its richness and complexity. The implications of these changing patterns of engagement for learning in the home.	In their everyday lives young people now had access to a rich variety of different ICT-based activities, and within the limits of their technical abilities. Using ICTs at home can support learning that may be formal, informal, quasi-formal or incidental. Some informal learning practices increase their sense of agency in relation to their learning and therefore potentially make learning a richer and more fulfilling experience. DOI: 10.1080/03054985.2011.577944
Gakhar 2007	USA K-12 teachers	The background and meaning of storytelling and follows with the articulation of the reasons why digital storytelling has become a buzz for both children and teachers in our schools and society.	Digital storytelling has become a popular multimedia tool in K-12 education. It has potential for making the teaching-learning process effective because it utilizes the age old tested process of learning through stories. A lesson plan is included to guide social science teachers to integrate digital storytelling in their classrooms. https://www.learntechlib.org/primary/p/24609/ .
Geyer 2009	USA 8 - 14-year-old students	Survey methodology using a mixed-method research The development and validation of a 32-item scale that measures Internet-Savviness (IS)	There were no statistical differences on dimension or total IS scores for participants in this study. Doing something creative, access at home, exchanging images, access speed, age, and access at a friend's house were statistically significant predictors of IS scores. https://doi.org/10.1080/19404476.2009.11462058
Goodall 2016	UK Parents of school age children	It examines the linked concepts of school–home communications, and parental engagement in children's learning, both of which are vital for supporting learning, particularly at times of transition.	The introduction of technology into the life of the school and communication with families can represent a considerable cost, both in terms of finance and in terms of teachers' time, and therefore decisions in these areas should be made on the basis of the best possible evidence. The paper concludes with challenges and recommendations for policy-makers, researchers and practitioners. https://doi.org/10.1080/22040552.2016.1227252
Grace 2014	Australia Young people aged 10–18	Pre and post assessments The impact of internet use for social networking on a range of outcomes and to gather emerging evidence in this area	The internet may be a viable tool in increasing the social participation of youth with CCN. However, some youth and their families required intensive support and technical assistance to gain confidence in internet use and in use for social purposes. DOI: 10.1177/0265659013518565

Grimes 2017	New Zealand Primary school children	Survey the impact of ultrafast broadband on schools' academic performance using a difference in difference study of a new fibre broadband network.	No evidence that gender, ethnic minorities or students enrolled in remote schools benefit disproportionately was found. However, some evidence of a larger benefit within schools that have a greater proportion of students from lower socio-economic backgrounds was identified. http://motu-www.motu.org.nz/wpapers/17_03.pdf
Gronn 2014	Australia Primary school with children aged 2 - 12	How the 'digital-disconnect' between home and school is experienced in children's lives	There were some difference in use across both settings, but also similarities associated with information retrieval, rote learning and entertainment. https://doi.org/10.1080/1475939X.2013.813406
Gündüz 2010	Turkey Elementary school students	Questionnaire The assessment of the digital divide conditions and the effects of digital divide on their level assessment exam (STS) success rank and school grades.	While most of the students, who ranked in top ten in the Level Assessment Exam (STS), have computer and internet in their homes, those who ranked "last ten" do not have computer and internet in their homes. This situation is primarily connected to the financial power of the families to buy computer and internet. https://eric.ed.gov/?id=EJ875762
Gurung 2014	US Students in grades 9- 12	Qualitative method How digital learners access and use various types technology in their learning engagement.	There was an overlap between the participants' personal digital engagement (PDE) and educational digital engagement (EDE); their digital habits, interests, and aptitudes functioned as the linking components between PDE and EDE. DOI: 10.1016/j.compedu.2014.04.012
Hartanto 2018	US 12-18 year-old students	Quantitative Compared frequency of using video games during the week and at the weekend with academic performance on standardised tests	A negative correlation between time spent playing video games during the week and academic performance; A positive correlation between time spent on video games at the weekend and academic performance in standardised tests in mathematics, reading and science. DOI: 10.1016/j.compedu.2017.12.007
Hartnett 2017	New Zealand Year 12 students	A mixed methods approach Home digital access and use of young people (16–17–years-old) from a range of socioeconomic backgrounds across New Zealand.	Differences in digital access do exist among young people from different socio-economic backgrounds. These differences include the number of digital devices in the home, the types of devices available, and whether the device(s) are shared or individually owned. Findings highlighted how young people (i.e, senior school students) from lower socio-economic groups prioritised their schoolwork when online because of the need to share access among family members. DOI: 10.1111/bjet.12430

Hatlevick 2013	Norway 15 year-old students	Web based survey with 120 items Factors predicting students' digital competence	The conditions at home, i.e. language integration and cultural capital, together with mastery orientation and academic aspirations did predict digital competence, and explained a substantial share of the total variation in digital competence. Cultural capital has a positive influence on students' digital competence. Language integration at home can predict increase in digital competence. DOI: 10.1016/j.compedu.2012.11.015
Hinostroza 2015	Chile Tenth grade students	Questionnaires The extent to which students' frequency of computer use and their computer use profiles are influenced by students' socio-economic group (SEG), computer use experience, ICT self-reported confidence, ICT skills, and gender.	Neither the years of ICT use, self-confidence, nor ICT skills were related to substantially different students' computer use profiles. Once students have access and begin using computers at home, they tend to distribute their time between different types of activities in a very similar manner. The only variable that discriminates user profiles is gender. DOI: 10.1080/17439884.2014.883407
Ihmeideh 2014	Jordan Parents of children an 1 st and 2 nd grades	Survey with Internet Parenting Style Scale and Internet Usage Scale. The Internet parenting style of Jordanian parents and their perspectives on their children's Internet use.	The authoritative Internet parenting style was the most commonly used style practiced by Jordanian parents, followed by the permissive and authoritarian parenting styles, with the neglectful parenting style being used the least. According to the parents, their children's Internet use typically involved playing games online and visiting websites. Only the authoritarian parenting style was a significant predictor of children's Internet use. DOI: 0256-8543, 0256-8543
Jara 2015	Chile 10 th grade students	Mixed method. The individual and home-level factors that influenced the performance of 10th grade Chilean students on the 2011 digital skills national test (ICT SIMCE).	The most important factors in developing digital skills are having access to a computer at home, linguistic capital, socioeconomic status, and years of experience using a computer. Students who scored highly on the test were generally able to focus and concentrate on their school assignments when using the Internet. These students also adopted cognitive and organizational strategies in order to be more effective. https://doi.org/10.1016/j.compedu.2015.07.016

Jesson, Meredith 2015	New Zealand Manaiakani cluster of schools, 6 decile 1 schools	Interviews with 40 families, (parents and children) and group interview with teachers. Gather perspectives about what sorts of home-learning activities might support school learning given that students have individual digital devices and access to the internet and class websites.	Finding 1: Differing perspectives were apparent about the relative merits of formal and informal learning activities Finding 2: While parents and teachers were in agreement about the role of parents to support students to make wise decisions about engaging in an online environment, less clear was what role parents might take in supporting learning. http://www.tlri.org.nz/sites/default/files/projects/TLRI_Jesson_Summary(v2).pdf
Jesson- TLRI report 2015	New Zealand Manaiakalani cluster of schools in Auckland. Teachers, students 9Year 5 – Year 13) and their parents.	The study employed a mixed methods design approach Factors enhancing and constraining students' learning at home in a low SES community.	Less time spent engaging in digital activities did not necessarily coincide with lower rates of learning, but that those with more engagement tended to be higher achieving or make accelerated gains. Students who achieved some of the highest gains across the year reported using both managing distractions and searching online for guidance as strategic tools. The relationship between home and schools as well as parents' engagement were influencing factors on children's learning. http://dx.doi.org/10.18296/set.0025
Jewitt 2011	UK "the Home Access Programme (HAP)" for low-income households with children aged 5–19 years.	Telephone interviews with parents/carers and 12 qualitative case studies of schools. The impact of HAP on the extent and nature of children's access to the HAP devices, the character of children's learning at home and parental engagement with their children's learning	HAP impacted positively on children and young people's computer access; it led to increased student time engaged in homework and independent learning activities on the computer at home. Evidence of increased parental engagement with their child's learning and benefits of HAP in relation to economic and social benefits at home was found. The pilot HAP made a material impact on closing the digital divide and delivered educational benefits for students and for households. https://doi.org/10.1111/j.1365-2729.2011.00434.x
Johnson, G 2009	Canada Children in first through sixth grade and their parents	Questionnaires Parents' perceptions on their children's online behaviours and their cognitive development.	Parents reported four types of Internet behaviour: <i>learn, play, browse, and communicate</i> . Children's ability to correctly define Internet terms as well as parent reported online learning and communicating (but not playing and browsing) were associated with increased cognitive scores. http://web.a.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=0&sid=69b3a33e-8c24-4002-9519-1e6c4738dcd4%40sessionmgr4009

Johnson, G 2010	Canada Children aged 5 – 17	Online survey The extent and nature of home and school Internet use during the early school years. Patterns of Internet use across environments (home and school) and with respect to type of use (exchanging email, visiting websites, and playing games)	Both at home and at school, young children reported using the Internet, in order of frequency, to play games, visit websites and exchange email. More young children used the Internet at school than at home but home-based use, compared to school-based use, was more often perceived as enjoyable. Three patterns: <ul style="list-style-type: none"> - Comprehensive home-based users - School-oriented information seekers - School-oriented communicators http://hdl.handle.net/20.500.11937/41084
Johnson, G 2010	Canada Children in third through sixth grade	Rating scale A description of children’s uses of the Internet across three environments (immediate home, school, and community environments) and comprehensive measures of child development.	Children overwhelmingly used the Internet at school and 80% reported using the Internet at home. Contexts of Internet use (home, school, and community) are associated with variation in the nature of online activities (communication, information, and recreation) during middle childhood. Various uses of the Internet at home and school were positively related to teacher evaluation of cognitive development. https://doi.org/10.1177/1476718X10379783
Johnson, G 2011	Canada Children in third through sixth grades	Questionnaires Gender differences in Internet activities among individuals born into the digital-age	There were no gender differences in school-based Internet use and only one gender difference in home-based use. Girls were significantly more likely than boys to report using email at home. Cognitive scores predicted girls’ email use at home and website access at school. http://web.b.ebscohost.com/helicon.vuw.ac.nz/ehost/pdfviewer/pdfviewer?vid=0&sid=97779238-cd2e-44be-b49b-bf60aa6232c2%40sessionmgr103
Johnson, G 2013	Canada Students in third through sixth grade	Self-reported questionnaires Patterns of relationship between traditional literacy skills and online communication for school-based and home-based Internet use.	Internet use during childhood is a complex behaviour that varies across children and across contexts. Instant messaging and community-based Internet use during childhood were associated with decreased literacy skills, while other applications used at home and school were associated with increased literacy skills. DOI: 10.1080/02702711.2012.65814
Katz 2017	USA Children aged 6 – 13 and their parents	Survey The internet connection type used by families, the technology experiences of lower-income parents, and their	Contextualizing children’s connectivity to account for infrastructural, socio-demographic, and relational influences provides new insights into the technology experiences of lower-income children.

		perceptions of opportunities that technology use offers their children.	Direct benefit from increased connectivity is most evident for lower income parents – those with the lowest household incomes, lowest levels of education, and whose dominant language is not English. That greater connectivity increases how frequently both children and parents use the internet, but is associated only with a greater scope of internet activities for parents. https://doi.org/10.1080/1369118X.2017.1379551
Khasawneh 2008	Jordan Parents of children aged 4 - 10	Questionnaire The effects of computer technology on Jordanian children from the perspectives of their parents.	Some of the positive as well as negative changes that have been manifested as a result of using computers. Children's behavior changes as a result of computer use. A large number of parents reported that their children familiarized themselves with computer functions and parts and technological and computer concepts, such as chatting, e-mail, and digital games. DOI: 10.2190/EC.39.3.d
Kingston 2013	US- Nebraska Eighth-grade students	The effect of a required yearlong one-to-one notebook computer program supported by high-speed Internet connectivity at school on (a) children's test scores.	The achievement gap between students eligible and students not eligible for free or reduced price lunch participation with or without high-speed Internet connectivity at home had been mitigated through participation in the school-wide one-to-one notebook computer program. https://digitalcommons.unomaha.edu/studentwork/40/
Kirwill 2009	Europe Parents of 6 – 17 year-old children	Survey Which parental mediation strategies may protect children against experiencing content risks online in general and in various childrearing cultures in particular.	All parents favor social mediation of the internet for children over strategies based on technical solutions. Favoring restrictive (by time or content) to non-restrictive mediation depends on a country's value orientation in childrearing. Analyses showed that each parental strategy has the potential to reduce the probability of children's experience of content risk online. However, the extent to which particular parental mediation strategies are protective differs across European childrearing cultures. DOI: 10.1080/17482790903233440
Kolikant 2009	Israel Students in public post-primary schools	Questionnaire Students' perceptions of the appropriateness and usefulness of the Internet for schoolwork and its impact on their views on the value of school learning.	A significant number of students use the Internet for school purposes. Most of the students who use the Internet believe that school learning has little value beyond grades and that they know better than adults how to learn using the Internet. With respect to their beliefs about the impact of the Internet on their potential for learning most of the students somewhat agreed that they have better study habits than previous generations. DOI: 10.2190/EC.41.4.b

Kolikant 2010	Israel Students in public post-primary schools	Interviews Students' considerations for using (or not using) the Internet for school purposes; and their perceptions of themselves in terms of learning, and the Internet's role in this respect.	The majority of the students, although they use the Internet and other ICT for school purposes, believed that their generation is not as good at learning as the pre-ICT generation. Several students explained the situation in terms of the school's failure to build on their abilities. Nonetheless, the majority believed that the Internet over-simplifies schoolwork (perceived primarily as the traditional processing of textual sources), which in turn diminishes learning abilities. https://doi.org/10.1016/j.chb.2010.04.012
Kong 2018	Hong Kong Parents of children from primary, secondary and special schools.	Methodology Questionnaire surveys and semi-structured focus group interviews. Parents' understanding of, support for and concerns about e-learning and proposed a school-parent partnership distributing responsibilities to parents and schools based on the results of the study.	A high correlation between parental understanding and support for e-learning although parents demonstrated only a basic level of understanding. Four types of parental support and six major areas of parental concern were identified. https://doi.org/10.1080/1475939X.2017.1317659
Kooiman 2015	USA Students aged 11–18.	Intrinsic Motivation Inventory (IMI) scale The efficacy of remote exergame participation between students	Exergaming over the Internet can provide students with a social experience that results in increased relatedness between participants versus playing by themselves against a non-player character (NPC). This relatedness can help students access the social standards for physical education when enrolled in OLPE. DOI: 10.1080/2331186X.2015.1045808
Latunde 2016	USA 130 parents of black students	Survey to identify the strategies and resources parents use in engaging with their children's education	Participants reported using two types of resources: programs and organisations geared specifically to Black students and their parents and social interactions through friends, parents, and the Internet. DOI: 10.7709/jnegroeducation.85.1.0072
Lau 2016	Hong Kong Secondary school students	Students completed a self-report paper-based survey. Parental education, parental information and communication technology (ICT) literacy, and	Irrespective of adolescents' gender, the three most important predictors of learning-related Internet usage were maternal education, paternal monitoring style, and maternal monitoring style. Male adolescents were highly influenced by maternal education and paternal parenting styles,

		parenting style as predictors of adolescents' home Internet use and usage	whereas female adolescents were highly influenced by maternal parenting styles and paternal education. Maternal permission style and paternal permission style were the most important predictors for male adolescents. https://doi.org/10.1016/j.compedu.2016.09.002
Lei 2009	USA and China Students aged 12 - 17	Questionnaires What affected students' use of the Internet, and how students' Internet use related to their learning.	Significant differences in online activities between American students and Chinese students were found in school, but not at home. Different pedagogical practices in these two cultural contexts led to the different uses of the Internet in school between American students and Chinese students. There were significant school/home differences in Internet use for American students, but not much school/home difference was found for Chinese students. DOI: 10.1080/07380560902906104
Lei 2012	China 7th–9th grade students	1,576 online surveys The relationship between home Internet access/parental support and student outcomes.	Students who had home Internet access reported higher scores than those without home Internet on all three dimensions: Computer and Internet self-efficacy, Attitudes towards technology and Developmental outcomes. Home Internet access and parental support were significantly positively associated with technology self-efficacy, interest in technology, perceived importance of the Internet, and perceived impact of the Internet on learning. http://dx.doi.org/10.3390/educ2010045
Leu 2015	USA Seventh-grade students	Performance-based assessments and questionnaire. The achievement gap in offline reading comprehension and online research and comprehension between seventh-grade students in an economically advantaged and an economically challenged school district	- There was a significant achievement gap favouring West Town students in offline reading scores, offline writing scores, and online research and comprehension scores. - A significant gap persisted for online research and comprehension after we conditioned on pretest differences in offline reading, offline writing, and prior knowledge scores. - West Town students had greater access to the Internet at home and were required to use the Internet more in school.at school. Differences were again statistically significant. DOI: 10.1002/rrq.85
Levin 2002	USA Middle and high school students	Qualitative study The attitudes and behaviours of Internet-using public middle and high	Internet-savvy students rely on the Internet to help them do their schoolwork; Internet-savvy students describe dozens of different education-related uses of the Internet; the way students think about the Internet in

		school students drawn from across the country.	relation to their schooling is closely tied to the daily tasks and activities that make up their young lives; many schools and teachers have not yet recognized much less responded to the new ways students communicate and access information over the Internet; and students say they face several roadblocks when it comes to using the Internet at schools. http://www.pewinternet.org/reports/toc.asp?Report=67/ .
Li 2010	Canada Students aged 13-14	Mixed method approach The effects of IB LE on secondary students' mathematics and science learning, this study implemented the model in a rural school and evaluated it. IBLE: a model of inquiry-based learning with e-mentor CII's inquiry model	IBLE had enhanced students' learning, most sig affective development, including increased motivation, broadened u augmented career awareness. Technology access and use at home was inconsistent amongst students and these disparities created a barrier for virtual communication and homework support. https://doi.org/10.1007/s11423-010-9156-3
Li 2010	China Ninth grade students	Survey (Instant Digital Competence Assessment (iDCA) tool) The digital competence status of a group of Chinese teenagers.	(1) participants' overall performance in the iDCA was just 'pass' rather than 'good' or 'excellent', which might imply that digital natives in China are not necessarily digitally competent; (2) there were big disparities among participants as regards their digital competence; (3) participants' digital competence differed depending on their schools and their ages; (4) participants' digital competence was not significantly influenced by such factors as having a PC or not, having the Internet or not at home, frequency of computers and Internet use. DOI: 10.1111/j.1467-8535.2009.01053.x
Li 2013	China Students aged 10–14.	Questionnaire The digital divide issues among Chinese children from an educational and social perspective.	Students' Internet access at home is better than that at school and is influenced by different factors including teachers' guidance, parental involvement, parents' education, inequality indicators or genders. There is high correlation between students' Internet self-efficacy and their exploring behaviours of Internet use and their academic performance. https://doi.org/10.1016/j.compedu.2012.08.001

Liao 2016	Taiwan Elementary and junior high school students	Survey of Students' Digital Literacy and Learning Opportunities (SSDLLO) in Taiwan in 2009. The extent to which students' characteristics, autonomy of use, family background and resource inputs may be associated with the digital self-efficacy of schoolchildren	<ul style="list-style-type: none"> - The differences in the observed student characteristics, autonomy of use, family background, and resource inputs between rural and urban students account for 35% of rural-urban digital inequality. - The number of computers in homes and schools, internet connectivity at home, mothers' educational level, and the number of weekly computer classes provided by the school play a significant role with regard to the digital inequality between rural and urban students. https://doi.org/10.1016/j.compedu.2016.01.002
Lim 2009	Singapore Students aged 7-18.	Survey Uneven Internet access amongst young people in Singapore and effects on technological fluency.	<p>Those with access at home had higher technological fluency. More likely to explore, those without access Internet, use is goal oriented. While systematic incorporation of IT into the national curriculum can encourage parity in basic exposure to online skills, developing greater Internet proficiency is more likely with home Internet access where parents are supportive, rather than controlling.</p> http://dx.doi.org/10.1111/j.1083-6101.2009.01488.x
Lips 2017	New Zealand 9-11 year old students	Focus group interviews of students How do 9-11 year olds experience the use of digital technology in their school and home lives.	<p>Factors and conditions affecting children's use and experience of digital technologies, namely: i) the children themselves; ii) the parents and home setting of the children; iii) the classroom teachers of the children; and iv) the children's school;</p> <p>Factors and conditions influencing children's use and experience of digital technologies i) access to digital devices and the Internet; ii) children's activities and learning online at school, at home and elsewhere; iii) children's behaviours online; iv) home-based factors affecting access and use; and v) school factors that are influencing digital access and learning.</p> https://www.researchgate.net/profile/Louise-Starkey/publication/318866818_Understanding_children%27s_use_and_experience_with_digital_technologies_Final_research_report/links/5a330bbaaca2727144edb218/Understanding-childrens-use-and-experience-with-digital-technologies-Final-research-report.pdf
Livingstone 2008	UK 12-17-year-old children and their parents	National survey Parental regulation of children and teenagers' online activities	<p>Parents implement a range of strategies, favoring active co-use and interaction rules over technical restrictions using filters or monitoring software, but these were not necessarily effective in reducing risk. Parental restriction of online peer-to-peer interactions was associated with reduced risk but other mediation strategies, including the widely practiced active co-use, were not.</p> https://doi.org/10.1080/08838150802437396

Livingstone 2017	8 European countries Parents of 6 to 14-year-olds in France, Germany, the Netherlands, Spain, Poland, Italy, Sweden, and the United Kingdom	Survey The subset of measures relating to parent and child online skills, risks and opportunities, and parental mediation.	There are 2 parental mediation strategies. (1) Enabling mediation is associated with increased online opportunities but also risks. This strategy incorporates safety efforts, responds to child agency, and is employed when the parent or child is relatively digitally skilled, so may not support harm. (2) Restrictive mediation is associated with fewer online risks but at the cost of opportunities, reflecting policy advice that regards media use as primarily problematic. It is favoured when parent or child digital skills are lower, potentially keeping vulnerable children safe yet undermining their digital inclusion. DOI: 10.1111/jcom.12277
Lou 2010	Taiwan Parents of sixth grade students	Survey The sixth grade students' parents' Internet literacy and parenting style on Internet parenting in Kaohsiung County in Taiwan.	The current situations of the sixth grade students' parents' behavior of Internet usage, Internet literacy, parenting style, and Internet parenting are explored and analyzed, and there are significant correlations among the students' parents' behavior of Internet usage, parenting style, Internet literacy, and Internet parenting. https://eric.ed.gov/?id=EJ908083
Lu 2014	China Students in grades 3 through 6	Survey How children use the Internet at home, and what factors impact their online behaviour in such contexts.	Children use the Internet for both entertainment and learning purposes and these two factors are correlated. However, factors influencing Internet use for the two purposes are to some extent different. The study suggests that there is a need to zoom in and analyze children's Internet use in informal contexts, rather than assume that learning at home is just an extension of learning at school. DOI https://doi.org/10.1007/s40692-014-0007-9
Lu 2016	Hong Kong secondary 2–5 school students	Questionnaires How and why they used new social media both in and outside of school to consume, share, and create content.	Whereas students tend to consume and share more social media content outside of school they create more in school. Perceived importance of sharing content with peers or others is the most significant predictor having positive impact on all social media activities, both in and outside school. However, the negative impact of self-regulation ability on outside school social media activities implies the conscientiousness of their social media engagement, which calls for a further investigation on the quality of the social media content. https://doi.org/10.1016/j.chb.2016.06.019

Lu 2016	East Asia 15 year-old students	Using the primary data from the Student Questionnaire (SQ) and ICTF Questionnaire (ICTFQ), PISA 2012. It examines students' evaluations of computer use for learning.	The results revealed differences not only among the Edu-systems but also between males and females. In addition, differences related to students' access to computer and Internet at home and family education levels were also noted in the study. Some aspects of the evaluations were significantly correlated with students' abilities, attitudes, interests, popularity, achievements, time spent on information technology (IT) at home, and use of IT at school. The results showed how middle and high school students in these countries and regions perceived the use of computer for learning. DOI: 10.1177/0735633116636771
Malamud 2011	Romania Children aged between 7 and 19	Interviews The impact of increased access to home computers on the development of human capital among low-income children and adolescents.	Children who won a voucher to purchase a computer had significantly lower school grades but show improved computer skills. There is also some evidence that winning a voucher increased cognitive skills, as measured by Raven's Progressive Matrices. http://dx.doi.org/10.1093/qje/qjr008
Mardis 2013	USA Children aged 15 or younger	Using data from the US Census 2010 Current Population Survey (CPS) School Enrolment and Internet Use Supplement and the State Broadband Initiative (SBI) Community Anchor institution (CAI) by national Telecommunications Infrastructure Agency. Broadband access and use in rural households with children. Broadband in rural schools.	Children in rural areas have access to broadband at home. Their limited use is due to issues relating to cost and availability. Children also have access to broadband through schools. There should be a focus on making informal learning space in schools accessible to raise awareness of the importance of home broadband. https://doi.org/10.1080/17439884.2013.783595
Martinez de Moretin 2014	Spain, Ireland, Bolivia, Chile 14-19 year old students	Questionnaires The relationship between Internet use and parental mediation in a cross-cultural sample group. The relationship between parental mediation in Internet use and television viewing.	In general, adolescents use the Internet most to communicate and least to shop. In between was looking up information, downloading and playing ; and total time spent is not excessive; communication is one of the principal social purposes of Internet use; Adolescents perceive parental mediation in Internet use mainly in relation to the time they spend surfing the net , with this result being observed in all 8 cultural contexts studied; Positive correlations between Internet use for information purposes and instructive mediation were found only on some cultures;

			DOI: 10.1016/j.compedu.2013.07.036
McElvain 2014	USA Mexican immigrants Pre- kindergarten through sixth- grade English learners	The academic and psychosocial effects of the Bridge Project after-school program on 25 pre kindergarten through 6th-grade English language learner	Program increased the children's reading comprehension by an average of 2.8 grade levels and increased children's English proficiency an average of 2.8 California English Language Development Test levels over a 2-year period. Parents also observed their children's growth in confidence, social skills, motivation, responsibility, and the ability to ask questions. https://doi.org/10.1080/15348431.2014.973568
NMSSA 2017	New Zealand. Year 4 and 8 students.	Questionnaire and interviews with teachers Student and teacher attitudes to use of digital technologies for learning. Included in survey access to technology at home.	The majority of students at both year levels had Internet access at home. Students from low decile schools had the most frequent opportunities to learn with digital devices, with two exceptions. Students from high decile schools had more frequent opportunities to 'Search for information on the Internet' https://www.educationcounts.govt.nz/_data/assets/pdf_file/0010/184987/NMSSA-2016-Using-Digital-Technologies-for-Teaching-and-Learning.pdf
Nguyen	Vietnam Children aged 9 to 11	Survey The disparity amongst children from rural and urban areas of North Vietnam towards Internet usage.	Children accessed the Internet more at home than at school. Children tended to get consultancy in problem-solving issues when using the Internet from teachers and not parents. Children exploited online resources when they are at home in relation to their study. Ineffective levels of parental engagement and supervision increased risks and hidden hazards for children in digital world. The majority of children participating in the study claimed to have used the Internet in their learning activities. DOI: 10.1108/IJEM-11-2016-0242
Nicholas 2017	New Zealand Children aged 5 to 13.	A multiple case study Teachers' perspectives on ways Elearning reinforced mathematics teaching, the most valued digital equipment and applications, and professional development in ICT support school wide mathematics teaching.	The cost of some programmes and the lack of Internet connections and computers in poorer homes did not allow for a level playing field for all children. Children from poor schools were disadvantaged by their low income home environments. New ICT learning approaches which have potential to raise achievement in mathematics are not being fully utilised due to inadequate professional development and lack of collaboration on effective approaches and support within and between schools. DOI: 10.1080/00131911.2016.1237476

Nikken 2014	The Netherlands Parents of children aged 2 - 12	An online survey Parents' guidance practices relate to their perception of online risks and positive influences of the Internet	Parents partly use the strategies: 'co-use', 'active mediation', and 'restrictive mediation'. They also utilize new strategies: 'supervision' and 'technical safety guidance'. Mediation was mainly predicted by the child's age and online behaviour (e.g., gaming, social networking), as well as by the number of computers in the home and the parents' gender, education and computer/internet skills. https://doi.org/10.1080/17439884.2013.782038
OECD	Worldwide School age children	Using data from PISA 2015 Students' well-being in four main areas of their life: their performance in school, their relationships with peers and teachers, their home life, and how they spend their time outside of school.	Many students spend a lot of their time on the Internet: 26% of students reported that they spend more than six hours per day on line during weekends, and 16% spend a similar amount of time on line during weekdays. These "extreme Internet users" are more likely to feel lonely at school, have low expectations of further education, and tend to arrive late for school. https://doi.org/10.1787/9789264273856-en .
Oldham Smith 2008	USA Families with school-aged children	The purpose of this ex post facto qualitative study was to investigate parental perceptions concerning the use of home Internet among rural African-American families.	Parents believed that home Internet benefited their family and their children's academic performance. They also said that grades improved and that their children did homework more consistently. https://www.learntechlib.org/p/123674/
Oyaid 2010	Saudi Arabia Students aged between 14 and 19	Quantitative research Students' use of ICT in school, out of school and their perceptions of and attitudes towards ICT	Students' use of ICT at school was limited as there was no Internet connection available and lack of adequate facilities. Students gained more ICT experiences from their usage and interaction with computers at home rather than at school. Students had positive attitudes towards ICT both at home and at school. Students perceived that ICT use had a positive impact on their education. http://helicon.vuw.ac.nz/login?url=http://search.ebscohost.com/login.aspx? direct=true&db=eue&AN=50504371&site=ehost-live
Ozcinar 2013	Turkey Parents of 5 year- old children	Using parent observation forms and interviews Parents' views of a Blog Based Parent Involvement Approach (BPIA) designed to secure parent involvement in education by	Approach increased both parents and students knowledge; children enjoy the activities and parents spend more time with their children; Parents became more competent and self-confident about working with their children and their education https://doi.org/10.1016/j.compedu.2013.01.012

		strengthening school–parent communication.	
Özgür 2016	Turkey Students in grades 3 – 10 and parents	A mixed method approach The most commonly preferred The relationship between Internet parenting style and child/parent characteristics, their Internet usage	The Internet parenting styles could be categorized as laissez-faire, permissive, authoritative, and authoritarian. A significant relationship was shown between Internet parenting style and child's gender and mothers' education level. As the students' age and grade level increased, Internet parenting styles that were interpreted as initially authoritative were later interpreted as laissez-faire. As the grade level increased, the Internet parenting style tended to lean toward laissez-faire. DOI: 10.1016/j.chb.2016.02.081
Park 2008	Korea Sixth-grade students (12-year olds)	The experimental study The impact of take-home computerized tests on children's retention in social studies	Teachers can focus on their instruction without worrying about the time used for testing and the extra time needed to change the classroom atmosphere after the test is over. Furthermore, teachers can utilise the test results to aid instruction. Students can use testing as a means of reviewing the material learned at school. Immediate feedback after the test can enhance learning. DOI: 10.1111/j.1467-8535.2007.00752.x
Pepe 2011	Turkey Students in the 6 th , 7 th and 8 th grades.	The questionnaire The status of playing computer games, class success and attitudes of parents in primary schools	There are significant differences in the type of computer games depending on the gender and the age variables. Those with Internet access at home play computer games more than those without Internet access at home. Those who play fewer computer games on the Internet are more successful than those who play more games. Parents of the participants generally keep indifferent. http://www.academicjournals.org/journal/ERR/article-full-text-pdf/OB5A3636670
Psetizki 2009	Uruguay Primary school children	Survey The One Laptop Per Child scheme	Now that all the schoolchildren have their computers, the authorities say that they will endeavour keep the schools connected, particularly those in rural areas, where many still do not have internet access. http://ensign.ftlcomm.com/ensign2/mcintyre/pickofday/2009/010october/october016/LaptopUruguay.pdf
Reynolds 2013	USA 8 th grade students	Used national assessment data (2009)	Student technology use in school is negatively associated with student mathematics achievement for all 8th grade students and race/ethnicity groups.

		Factors of student technology use in school and outside school and student's mathematics achievement levels	Student technology use outside school is positively associated with student mathematics achievement for all 8th grade students and race/ethnicity groups. There were some differences between race/ethnicity groups when examining the significant relationships between student technology use, test motivation, student math self-concept, and home environment. https://search.proquest.com/docview/1370282156?pq-origsite=gscholar
Rivers 2004	New Zealand	The evaluation reports of the four Digital Opportunities Pilot Projects and Generation XP, FarNet, Notebook Valley, and Digitally Boosted Study Support Centres which took place in 2002 and 2003.	The evaluations show that the initiatives had a positive effect in raising the ICT profile within schools and improving the skills of staff and students in using ICT. The model had high level goals of bridging the digital divide and enhancing teaching and learning through the introduction of ICT. The experiences of the four projects raised the issue of the extent to which ICT has the power to transform classroom teaching. http://www.minedu.govt.nz/web/downloadable/dl10234_v1/digi-opps-summary.pdf
Robin 2008	USA	The history of digital storytelling and how it is being used educationally.	The theoretical framework, technological pedagogical content knowledge (TPCK), is described, along with a discussion of how this model might be used with digital storytelling. https://doi.org/10.1080/00405840802153916
Rolleston 2014	Vietnam Grade 5 pupils	Questionnaires and tests Gaps in school achievement between pupils from less advantaged backgrounds. The association between these characteristics and school attainment.	All pupils could get equitable access to school quality. There was a difference in teachers' characteristics for advantaged and disadvantaged pupils. There was a significant difference in opportunities to learn outside schools for advantaged and disadvantaged pupils. DOI: 10.1080/03054985.2013.875261
Sad 2016	Turkey Parents	Semi-structure interviews Parental e-nvolvement (or electronic parental involvement)	Most parents used or had their children use a variety of technologies particularly tablets, computers, and Internet. Parents reported many positive aspects of using technology in the process of involvement such as supervising their child's academic, social, or personal well-being at school, improving technology literacy, enhancing academic achievement of children. Parents had concerns about harms and risks of technology and used different strategies to prevent children from the harms and risks.

			DOI: 10.1080/22040552.2016.1227255
Sampath Kumar 2016	India Tenth-grade students (about 16-17 years old)	Interviews with students Questionnaires distributed to the head/principals of the high schools The expectations of rural students with respect to their computer access and use.	The percentage of students who were not using computers in rural high schools was high. The main reason was the lack of support from teachers and parents and the non-availability of a computer at home and schools. All students had positive attitudes towards computer use and preferred to learn how to use computers with the help of teachers. DOI: 10.1108/QAE-03-2014-0012
Selwyn 2009	England Pupils aged between 7 and 11	Questionnaire Children's engagement with information and communication technologies (ICTs) inside and outside the school context.	Primary pupils' actual engagement with ICT is often perfunctory and unspectacular. Whilst the majority of children felt that ICT use led to gains in learning, the paper discusses how there was a strong sense of educational uses of ICTs being constrained by the nature of the schools within which 'educational' use was largely framed and often situated. DOI: 10.1111/j.1467-8535.2008.00876.x
Seo 2011	South Korea Five-year-old children	Surveys The relationship between young children's habitual computer use and influencing variables on socio- emotional development.	For computer use both in the home and in the classroom, children with a higher score on the Internet Addiction Scale had a lower score on the Socio- Emotional Development Scale. Conversely, children with a higher score on the Socio-Emotional Development Scale had a lower score on the Internet Addiction Scale. Moreover, variables regarding children's computer use at home influenced the children's score on level of habituation more than variables of their computer use in the classroom. https://www.tandfonline.com/doi/abs/10.1080/03004430.2011.536644
So 2017	Korea Students aged 12 through 18	A cross-sectional nation-wide study The relationship between academic performance and Internet use according to its purpose and a wide range of use durations.	Internet use for study showed significant positive correlations with higher school performance. Internet use for general purpose was associated with lower school performance. Internet use for general purpose may have some positive aspects on school performance such as reenergizing students from burden and stress, or being a favourable source of socioeconomic support for achieving better school performance. The effects and purposes of Internet use differed according to income level. http://dx.doi.org/10.1371/journal.pone.0174878

Soh 2018	Malaysia Students aged 13 - 15	The cross-sectional survey Whether the engagement of parental mediation activities mitigates or compounds the situation.	The compensatory-competition model prevailed in the context of youths' online risky activities. Child-parent attachment was not significantly related with risky online behaviour. Close parent-child attachment is sufficient to deter children risky online activities. Child-peer attachment significantly correlated with risky online activities. https://doi.org/10.1016/j.tele.2017.11.003
Sorbing 2012	Sweden Children aged 13 – 17 and their parents	Survey Parents' worries and concerns in relation to their teenagers' use of the Internet.	Parents' worries and concerns vary, in certain aspects, according to age and gender of the child. Furthermore, parents' own Internet skills, experience of using the Internet, and attitudes toward the Internet are related to the type and nature of their worries and concerns. Parents' beliefs about their teenager's skills in using the Internet and the teenagers' Internet use and experiences are related to the parents' concerns. Parents with an accurate understanding of their children's negative Internet experiences are those who are the most worried. https://doi.org/10.1177/0192513X12467754
SQW	UK	Survey The evaluation of the Home Access Programme,	A number of positive indications that the programme is leading to improved outcomes in terms of enhanced use of home access for education. Beneficiary learners are on average using a computer 10.1 hours per week at home, of which 4.7 hours are on learning-related activities. There was strong agreement amongst interviewed children that having the Home Access computer is making learning more interesting, lets them use a computer much more often to help them learn, and is helping them to do better at school. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/181525/DFE-RR132.pdf
Starkey 2017	New Zealand Primary school teachers, students and parents	Interviews How can the introduction of netbooks with internet access, influence home learning in a low socio-economic community?	The children in this study demonstrated agency and autonomy in their learning at home. They were motivated and enjoyed using their Chromebooks for homework. The parents were highly supportive of their children's learning but sometimes felt they lacked the knowledge or skills to be able to teach them or assist with the school based tasks at home. https://www.researchgate.net/publication/321807810_School_initiated_learning_at_home_in_a_digital_age_2017_Final_Report

Starkey 2018	New Zealand 9-11 year old students	Focus group interviews of students How do 9-11 year olds experience the use of digital technology in their school and home lives.	6 profiles are described. The age of student is relevant to the type of interactions and experiences they have with digital technologies in the home. This has implications for the home/school education programme- needs to be relevant to age. https://doi.org/10.1080/1369118X.2018.1472795
Stross 2010	Peru and Uraquay	One Laptop Per Child	When a child owns a laptop, he added, the school day is effectively extended from a few hours to 12 to 14 hours — however long the child is awake, and wherever he or she happens to be. http://www.globaldialoguefoundation.org/files/EDU.2010-apr.twobillionlaptops.pdf
Uğur 2010	Turkey Children aged 6 – 13	Questionnaires The new media preference of the children	The majority of the participants have Internet access at home, and use the Internet. Children commonly use internet to play games, to communicate with friends, but few children use internet to seek information or to do homework. DOI: 10.3991/ijet.v5i4.1321
Valcke 2010	Belgium Students aged 9 - 13	Survey Internet parenting styles are defined and operationalized to study the impact on actual Internet usage of children at home.	Parenting styles are identified permissive, authoritative, laissez-faire, and authoritarian. The highest child usage level is with a permissive parenting style; the lowest level is observed when parents adopt an authoritarian Internet parenting style. The variables Internet parenting style, parent Internet behaviour, and parent educational background significantly predict Internet usage of children at home. https://doi.org/10.1016/j.compedu.2010.02.009
Van Deursen 2013	Netherlands Secondary school students	Students' assignments on the Internet Online skills: operational, functional; internet information and strategic skills	Level of information and strategic Internet skills among Dutch secondary students have much room for improvement. Information and strategic skills improved with education level. The level of information and strategic Internet skills among secondary students has a weak relation with Internet experience and the amount of hours spent online weekly. https://www.sciencedirect.com/science/article/pii/S0360131512002916
Vandersall 2014	USA	Survey	The highest percentage of students are using the web in the 9 a.m. and 11 a.m. time blocks, with significant percentages doing so immediately after school. The patterns generally follow the same contour by school type, with

	Teachers and children in grade 4 to 12	The One - to - One Computing Initiative at Sunnyside Unified School District (SUSD)	<p>HS students more likely to have accessed the web late in the evenings and night time.</p> <p>The highest percentages of students used Reading Plus, Lexia, Conceptua Maths and Discovery Ed.</p> <p>Students visited, on average, approximately 17 different domains each day. Students most frequently used sites categorized as search engines, business services, and software/technology. High school students were more likely than other grade levels to use online research tools outside of traditional search engines.</p> <p>Staff accessed between 27 and 46 domains a day, depending on the grade level of the assigned school.</p> <p>This report is not publicly available- reported here with permission of author</p>
Vitalaki 2012	Crete Parents of primary school students	A survey questionnaire Which factors contribute to children's less exposure to harmful Internet content regarding parents' attitudes and perceptions when children use the Internet for various activities.	<p>Parents' technological efficacy is strongly related to their better evaluation of the Internet hazards and their effectiveness in promoting Internet safety awareness when navigating with their children at home.</p> <p>https://www.researchgate.net/profile/Giorgos_Tsouvelas/publication/225029192_FACTORS_INFLUENCING_PARENTAL_CONTROL_FOR_THE_SAFE_AND_PEDAGOGICAL_INTERNET_USE_AMONG_PRIMARY_SCHOOL_STUDENTS/links/54250dab0cf26120b7ac4f5f.pdf</p>
Wainer 2015	Brazil 5th and 9 th students	Using results in Prova Brasil tests for competencies in Portuguese and Mathematics. The association between having home access to a computer and to the Internet and the educational achievement of primary students on a standardized test	<p>The results show a significant (both practical and statistical) benefit of owning a computer for 5th and 9th graders.</p> <p>The correlation between having access to the Internet with higher test scores is generally smaller and highly dependent on the socioeconomic status of the student's family.</p> <p>Results also show to a weaker evidence that there is an increase of the positive effects of owning a computer and access to Internet over time.</p> <p>https://doi.org/10.1016/j.compedu.2014.08.007</p>
Wang 2012			
White 2016	New Zealand Year 4 to 10 students	Where groups of students in this cluster of schools are making significant gains (or minimal progress) in their achievement and how the use of technology in the	Score ranges in all tests were similar for both netbook users and non-netbook users in each year level with no clear trends distinguishing between the two groups.

		classroom might play a part.	If there is any effect of netbooks on achievement, it may be that differences between students using netbooks and those not using netbooks become apparent after an extended period of time using the technology. DOI: 10.13140/RG.2.2.33689.21608
Wilkin 2017	UK Students aged 11 - 18	Qualitative study The experiences of young people living in England, who were provided with a free internet connection and laptop, alongside skills training as part of a two-year school and council-run initiative. How the conflicting essentialist discourses surrounding young people and technology influence how digital inclusion schemes are enacted and experienced, and affect the scheme's outcomes.	Most young people remained relatively narrow consumers of the internet. For some young people there were clear social and learning benefits, but their uses of the laptop and internet at home did not have for the most part a 'transformational' impact on their education and everyday lives in line with the more optimistic expectations of one-to-one initiatives. The discourses around young people and technology were: the positioning of young people (motivation & interest), familial factors (expectations, safety), and conflicting school cultures (support, formal/informal learning, academic achievement) https://doi.org/10.1080/03054985.2017.1305058
Won 2010	USA & Korea Middle school students	Data from the Trends in International Mathematics and Science Study (TIMSS) 2003, The relationships between American and South Korean students' achievement and their time spent in out-of-school activities.	Korean students spent more than 30% of their out-of-school hours using the Internet and playing PC games, whereas American students spent about 27% of their out-of-school hours playing sports and working at home or a paid job. In both nations, time spent in reading books was positively associated with achievement, whereas watching TV, playing PC games, completing jobs at home, working a paid job, and using the Internet were negatively associated with achievement http://dx.doi.org/10.1177/1932202X1002100404
Wong 2015	China Households with children age 9–17.	Questionnaires Whether a difference in the Internet access of children was associated with their academic and psychosocial attributes.	The digital divide for low-income children in Shanghai is getting smaller or even closing, but the urban–rural divide might be a factor in aggravating digital exclusion. Low-income-no-Internet children reported significantly lower scores on all dimensions of digital literacy, academic performance, aspirations, perceived efficacy, self-esteem, family and peer relationships. Low-income children with Internet access did not show significant differences with non-low-income group across all dimensions. While

			http://dx.doi.org/10.1080/15228835.2014.998576
Wu 2014	Taiwan Students in 4th to 6th grade.	A self-reported questionnaire Whether digital divide exists between elementary school aged children with learning disabilities (LD) and their nondisabled peers in Taiwan.	No significant difference in the opportunities to access computers and the Internet at home and at school between children with and without LD, but the children with LD performed poorer than their peers in almost all six computer skills. Students without LD enhanced their computer competency gradually year by year, but students with LD eventually did not. https://doi.org/10.1016/j.chb.2014.06.024
Xu 2011	Korea	Experiment study The effects of writing for digital storytelling on writing self-efficacy and on flow in the virtual reality learning environment known as Second Life.	The results of the experiment demonstrate that digital storytelling in a virtual learning environment is more effective than digital storytelling off-line. The findings of this study suggest that the technique of digital storytelling can be used effectively in classroom settings to teach writing. http://link.galegroup.com/apps/doc/A276518117/AONE?u=vuw&sid=AONE&xid=737f06b7
Yapici 2012	Turkey 9th grade students.	A scale of learners' views The high school students' views on blended learning.	Students' views were "highly" positive. The blended learning model provided students with various opportunities such as getting prepared for the lessons, reviewing the lessons as many times as wanted, reaching the subject-related materials without being dependent on time and place, testing oneself and communicating with the teacher and other students out of the school. There were various problems though such as lack of Internet connection at home and problems experienced while playing the videos. https://doaj.org/article/1b93eb4cdb6e46d4b12c2d1e5dcb52fc
Yelland 2013	Australia Parents and school age children	Survey and interviews The ways in which they perceived having the computer had impacted on their lives and those of their school aged children.	All family members felt that the ownership of a computer enabled them to feel more confident about their active participation in everyday educational, social and community activities. Students noted the increased ease with which they could complete school work and communicate with friends in online contexts and outlined some of the ways in which they used the computer for leisure activities. https://doi.org/10.1007/s10639-012-9223-y
Yildiz 2014	Turkey Students in 7th and 8th grades.	Surveys The current state of ICT access and ICT literacy, two indicators of the digital divide, and to assess democracy awareness of seventh	35% of students had neither a computer nor access to the Internet, which suggests a digital divide between this group of students and others in ICT access. Students' democracy awareness did not significantly differ depending on household ICT access. In other words, there was no significant difference between the students with and without household ICT access

		and eighth grade students in reference to these indicators.	http://helicon.vuw.ac.nz/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=95703056&site=ehost-live
Zaman	Belgium Families with children between 3 and 9 years old	Participants' diaries and interviews. Parental efforts toward diverse uses of digital media by young children and adhere to a broad categorization of mediation.	Five mediation strategies were identified as restrictive mediation, co-use mediation, active mediation, participatory learning and distant mediation. Restrictive mediation included content, time (in previous studies), device, location, and purchase restrictions (new manifestations). Distant mediation aggregated two previous defined monitoring practices, namely deference and supervision. https://doi.org/10.1080/08838151.2015.1127240
Zhang 2015	USA Children aged 3 - 21	Using data from the U.S. Department of Education. Interest in and usage of two highly popular websites that primarily target children and adolescents: KhanAcademy.org and CartoonNetwork.com. The former represents a capital enhancing use of the Internet, while the latter represents an Internet use for entertainment.	High sociodemographic status was positively correlated with interest in Khan Academy, while low sociodemographic status was positively correlated with interest in Cartoon Network. This study provided some evidence that existing educational inequalities may be reproduced through unequal Internet use. https://doi.org/10.1016/j.compedu.2015.08.007
Zhao 2010	China High school students	Survey The relationships between constructs of technical apparatus, autonomy of use, availability of social support, variation of use at different locations of Internet access (school, home, Internet cafe, and combinations of these locations) and Internet self-efficacy (ISE). The relationships between ISE and high school students' exploratory behaviour and academic.	Different dimension of Internet inequality had different relationships with ISE. Home Internet accessibility positively related to ISE. Availability of social support from school had a greater effect than that from home as parents influence did not associate with ISE. At home and Internet café, the relationship between leisure use and ISE was stronger than that between study use and ISE. As to the outcome of ISE, high levels of ISE were positively related to exploratory behaviors, and for those students who used the Internet at school and home, higher ISE related to better academic performance. https://doi.org/10.1016/j.compedu.2010.05.010

Zhong 2017	New Zealand Primary school children	Quantitative comparison using propensity score matching and linear regression. Do students who joined a netbook scheme achieve better results than those without a netbook?	Little difference between the students (no or small statistical significance of difference). Further investigation is warranted to explore the use of netbooks on the development of punctuation, structure and language, and reading (for low achieving students) https://www.researchgate.net/publication/321807989 2016 cluster report _netbooks and student achievement
Zilka 2017	Israel Children aged 8-12	Mixed-method study The browsing and viewing habits of children aged 8-12 from various localities across Israel, and their habits of sharing with their parents, family members, and friends, the watching of television shows and surfing the Internet, and the use of the computer among children who did not have a computer at home and received a desktop or a hybrid computer to use at home.	The sharing habits adopted by children who had no computer in the home and were provided with one were affected not only by the new computer itself, but also by the manner of interaction with their parents and by the television viewing habits they had acquired before the computer reached the home. Children were afraid of being criticized for their choice of programmes, the characters they admire, and the sites they browse, and this fear causes them to avoid dialogue, joint viewing, and browsing with others. http://jite.org/documents/Vol15/JITEv15ResearchP233-251Zilka2679.pdf
Zilka 2016	Israel Children of low socio-economic status aged 8-12	Mixed-method study. The degree of effectiveness of receiving a desktop or hybrid computer for the home in reducing the digital divide among children of low socio-economic status aged 8-12 from various localities across Israel.	After the children received desktop or hybrid computers, changes occurred in their frequency of access, mobility, and computer literacy. Most children logged in from home to the Internet learning environments used in the school. Most children processed information obtained from the Internet using data processing tools, typically word processors and graphics software. Many children expressed a desire to continue their studies and expand their knowledge of computer applications, software, games, and more. https://doi.org/10.26634/jet.14.3.13855

Appendix 2: Interventions

Jurisdiction	Policy name, dates, funding	Policy elements
<p>Singapore</p>	<p>The Singapore government provides a two year subsidy for Singapore citizen applicants under the age of 25 and studying at school or post school to own a new computer with free software and three years if free subscription to broadband services. This is targeted a households with a monthly household income less than \$3,400 SG. Students unable to meet the co-payment with monthly household income <\$2,500 can be funded in return of 3-12 hours of community service.</p> <p>Schools can also receive a grant to process, procure and deploy Internet broadband services, devices and software for students from low income families.</p> <p><i>www.moe.gov.sg or www.gov.sg</i></p>	<p>Those with access at home had higher technological fluency. More likely to explore, those without access Internet, use is goal oriented. While systematic incorporation of IT into the national curriculum can encourage parity in basic exposure to online skills, developing greater Internet proficiency is more likely with home Internet access where parents are supportive, rather than controlling.</p> <p>[See Lim [56]]</p>
<p>Norway</p>	<p>https://www.globalcitizen.org/en/content/bergen-norway-Internet-kids-universal-access/</p>	<p>In recognition of the Internet as a vital tool for education, Bergen, Norway — the Scandinavian country’s second-largest city — has moved to provide online access to all children.</p>
<p>Europe</p>	<p>European Union Joint Research Committee analysis of reports across 19 European countries on 1:1 initiatives and a literature review; 31 recent 1:1 initiatives that involve approximately 47,000 schools and 17,500,000 students in primary and/or secondary education.</p>	<p>Evaluation reports from 1:1 initiatives provide evidence of impact on motivation; student centred learning; teaching and learning practices; learning outcomes; and parents' attitudes. Almost all the evaluation reports refer to students being more motivated when using the given devices. According to some of the reports the motivation could be maintained longer term when devices were regularly used; when students were able to work and do exercises independently with learning software giving them immediate feedback; when students had the possibility of carrying out research on the Internet, presenting the results of their work, and exchanging more easily with other students.</p>

<p>USA: Arizona</p>	<p>Sunnyside Unified School District in Tucson, Arizona, is an example of a district pursuing strategies to connect students when they are off campus. It is the 13th largest school district of the state with 19 schools. Nearly 90% of the district's 17,265 students identify as Hispanic. Additionally, nearly 30% of the student population are classified as English language learners, and 14% of the population receive special education services.</p>	<p>Many families within the district could not afford Internet access at home. Approximately 86% of students are eligible for free or reduced price meals. This issue was exacerbated by the lack of infrastructure to provide adequate connectivity, given the expansive geography the district serves.</p> <p>To provide access, the district offered free/reduced cost WiFi to families, enabling students to access the Internet and do homework at home. In Spring 2012, <i>Connect2Compete</i> launched a pilot program in 60 San Diego schools to provide Internet service for families who qualify for free lunches. That fall the program was expanded to target 1,000 schools nationwide (including Tucson). 75% of all students in the school now have Internet access.</p> <p>http://digitalpromise.org/2014/04/07/11-learning-24-7-at-sunnyside-unified-school-district/</p> <p>In 2008, when the initiative began, the district's graduation rate of 71 percent was eight points behind the state average. It is now 82 percent, according to the Arizona Department of Education. While the 1:1 initiative is not the only cause of this increase, Sunnyside believes digital technology has made an impact.</p>
<p>US:</p>	<p>ConnectHome</p> <p>ConnectHome is a U.S. Department of Housing and Urban Development program focused on increasing access to high-speed Internet for low-income households. The pilot program launched in 27 cities and one tribal nation in the summer of 2015, initially reaching more than 275,000 low-income households and nearly 200,000 children. As part of the program, Internet service providers, nonprofits, and the private sector will offer broadband access, technical training, digital literacy programs, and devices for residents in assisted housing units.</p>	<p>Bringing Connectivity to the Poorest Communities: Coachella Valley, California</p> <p>When Coachella Valley Unified School District made the decision to implement a plan to transform learning through technology, the plan's architects quickly realized that round-the-clock access to high-speed Internet was essential to create connected learning opportunities in and outside of school. However, because of broad socio-economic diversity in the district, equity of access was a challenge.</p> <p>Geographically, the district draws from Riverside County, California, and serves the city of Coachella, the community of Thermal, portions of the city of Indio, and Salton City in Imperial County, educating</p>

		<p>more than 18,000 students across 25 schools. The local cable company refused to run fibre through Native American reservations in the area or through a local mobile home park, leaving some of the district's highest need students on the outside looking in when the school day ended.</p> <p>To answer the challenge, the district equipped 100 of its school buses with wireless Internet routers with rooftop solar panels to supply power. This enabled students to connect to the Internet on the way to and from school and while traveling to sporting events and extracurricular activities. In addition, at night the Wi-Fi-equipped fleet parked in some of the poorest areas of the district, making high-speed Internet available to students virtually anytime and anywhere.</p> <p>The initiative was not without challenges. Leadership needed buy-in from the community and the teachers' union, whose members draw salary and benefits from the same general fund. District leaders obtained community buy-in through high-touch outreach that included committee meetings and focus groups as well as speaking directly with or sending e-mail to individual community members. Superintendent Darryl Adams focused on building a bridge between the vision of success that everyone deeply desired for the district's students and the concrete means to realize that vision.</p> <p>Buoyed by the success of this initiative, Coachella Valley now has a long-term plan for the district to become its own Internet service provider, breaking its dependence on commercial telecom companies.</p> <p>https://www.huduser.gov/portal/sites/default/files/pdf/ConnectHome-Brief.pdf</p>
US: Santa Barbara	Computers for families programme:	

	Appears to be a refurbished reuse programme	
US: California	<p>Students in grades 6–10 in 15 different middle (most of sample) and high schools in 5 school districts in California. Middle school students were poorer (81 percent free or reduced price lunch compared with 57 percent) and have a higher percentage of minority students (82 percent to 73 percent) than the California average; Any student who reported not having a home computer was eligible for the study;</p> <p>Of 1,123 participants, 559 were randomly assigned to the treatment group; average age of study participants is 12.9 years; high concentrations of minority and non-primary English language students: 55 percent of students are Latino and 43 percent primarily speak English at home.</p> <p>The computers were purchased from or donated by Computers for Classrooms, Inc., a Microsoft-certified computer refurbisher located in Chico, California. The computers were refurbished Pentium machines with 17" monitors, modems, Ethernet cards, CD drives, flash drives, Microsoft Windows, and Microsoft Office (Word, Excel, PowerPoint, Outlook). retail value of the machines was approximately \$400–\$500 a unit (see Fairlie and Robinson [8])</p>	<p>The results suggest that computers do not have an impact on grades for students at any point in the distribution.</p> <p>The schools participating in the study provided us with a rich set of additional educational outcomes. From administrative data we examine total credits earned by the end of the third and fourth quarters, the number of unexcused absences, the number of tardies, and whether the student was still enrolled in the school at the end of the year. These measures of educational outcomes complement the results for grades and test scores; treatment students are no more likely to be enrolled in school at the end of the year than control students. Taken together, these results on additional educational outcomes support the conclusions drawn from the grade and test score results of no effects of home computers.</p> <p>Although the experiment substantially increased computer ownership and usage without causing substitution away from use at school or other locations outside the home, <u>we find no evidence that home computers had an effect (either positive or negative) on any educational outcome, including grades, standardized test scores, or a host of other outcomes.</u> Our estimates are precise enough to rule out even modestly-sized positive or negative impacts.</p>
US: Piedmont City Alabama (School District of 3 K-12 Schools, serving 1200 students making this similar to an NZ COL)	<p>School Board the initiated “MPower Piedmont” in 2009. The initiative placed a laptop computer in the hands of every student in grades 4-12. Funding was later secured to build a citywide wireless network to provide constant Internet access to students.</p> <p>The Piedmont City School District is one of ten charter members of the <i>Digital Promise League of Innovative Schools</i>. The League of Innovative</p>	<p>By 2017 every student in the Piedmont City School District had a device. Students in grades K-3 use iPod, iPad, and Macbook. Students in grades 4-12 are issued a personal Macbook Air.</p> <p>The 1:1 device initiative and wireless network allows every student in the Piedmont City School District access to 24/7 on-demand learning.</p> <p>[Not evaluations of student outcomes found so far – emailed the district Superintendent]</p>

	Schools was created by Congress to transform teaching and learning in America's public schools through the innovative use of technology.	See http://digitalpromise.org/our-reports/
US: Piedmont Unified School District, Alabama	<p>Connected Learning Initiative is one response to preparing students for college and career readiness in the 21st century.</p> <p>Students in grades 4-12 have one to one access to a mobile learning device, a 11" Chromebook. Grade 6-12, the device is available to students at school and at home to:</p> <ul style="list-style-type: none"> — Connect student to student and student to teacher with collaboration, — Connect to content on the Internet with research — Connect learning at school and home with a mobile device 	<p>Connected Learning Pilot report 2014-15 https://sites.google.com/a/piedmont.k12.ca.us/connected-learning/about</p> <p>Showed prior to the intervention, 69 % of students were sharing a device at home. Afterwards 99% were using Internet at home;</p> <p>Data from teachers shows a positive impact on learning; more student engagement and assignments turned in; more rapid feedback/ formative assessment.</p> <p>Identified need for support for parents to manage home access.</p>
US: Congress Initiative-Digital Promise League of Innovative Schools	<p>A coalition of 93 forward-thinking school districts in 33 states, serving more than 3.3 million students. Membership in the League is based on a combination of superintendent and school district qualifications.</p> <p>Partnering among leading entrepreneurs, researchers, and education leaders.</p> <p>e.g. Verizon Learning Schools Initiative equipped every child and teacher in select low-income middle schools across America with a tablet and two-year data plan as well as extensive professional learning opportunities for teachers and school leaders. Each Verizon Innovative Learning school receives a stipend for a Learning Coach to assist with program implementation, teaching support, and collaborative learning.</p>	http://digitalpromise.org/our-reports/
US: Huntsville, Alabama	Digital Curriculum and 1:1 computer provision plus other school improvement strategies (e.g. Teacher PLD) in 42 Schools in Huntsville School District.	

Digital Curriculum and 1:1 access programme	Multi-stranded intervention including 24/7 Internet access and 1:1 computers. [See Vandersall, Frank [140]]	
US: Omaha, Nebraska	In 2008. Westside Community Schools – District 66, in Omaha, Nebraska implemented a one-to-one notebook computer take home model for all eighth-grade students. Westside’s 1-to-1 technology initiative began with high school in 2004, was expanded in 2008 to include our middle school 8th graders. In 2014 Westside Board of Education unanimously voted to provide every student with a personal learning device beginning with the 2014-15 school year. 7th-12th graders use laptops while kindergarten through 6th grade students use iPads.	The achievement gap between students eligible (free or reduced price lunch) and students not eligible for participation with or without high-speed Internet connectivity at home had been mitigated through participation in the school-wide one-to-one notebook computer program. [See Kingston [36]]
US: Obama Administration	ConnectED Series of PPPs initiated in the term of the Obama presidency (2009-2016) to deliver multiple aspects of connectivity.	The final posting on the ConnectED initiative claimed that it was on track to connect 99 percent of America’s students to next-generation broadband and high-speed wireless in their schools and libraries by 2018. The Federal Communications Commission (FCC) and companies like Apple, Microsoft, Sprint, and Verizon have provided their support for the programme. ConnectED aimed to provide better broadband access for students in rural areas, by expanding successful efforts to connect parts of the country that typically have trouble attracting investment in broadband infrastructure. <i>https://obamawhitehouse.archives.gov/issues/education/k-12/connected#schools</i>
UK	Home Access Programme A total of £194 million was spent on the Home Access Programme – substantially less than the £300 million originally envisaged. Intended impacts:	See programme logic p.10 application documents and marketing materials were in the English language only, a significant issue given that a fifth of eligible pupils would have been from families which do not have English as their first language;

	<ol style="list-style-type: none"> 1. Reduction of the current inequity (closure of the digital divide) 2. Enhanced educational attainment 3. Increased parental engagement with skills development <p>See SQW [7], p.10</p>	<p>programme rapidly succeeded in achieving its target number of beneficiaries. Including the pilot phase, the total number of households benefiting from the programme was 267,244 – approximately 4.5% of England’s six million households with dependent children;</p> <p>enhanced use of home access for education: Beneficiary learners are on average using a computer 10.1 hours per week at home, of which 4.7 hours are on learning-related activities. There was strong agreement amongst interviewed children that having the Home Access computer is making learning more interesting, lets them use a computer much more often to help them learn, and is helping them to do better at school.</p> <p>enhanced attitudes to technology amongst parents: The vast majority (89%) of interviewed parents agreed that the Home Access computer is something the whole family can use, and most (57%) agreed that they were themselves more interested in using the Internet than they were before they got the Home Access computer.</p> <p>impact on reducing the digital divide, we estimate that the programme accounted for a net increase in home access of approximately 167,000 households – equivalent to about 2.8% of England’s households with dependent children.</p> <p>[See Jewitt and Parashar [37]]</p>
UK: BECTA	<p>Becta, originally known as the British Educational Communications and Technology Agency, was a non-departmental public body funded by the Department for Education and its predecessor departments, in the UK. It was a charity and a company limited by guarantee. The abolition of Becta was announced in the May 2010 post-election spending review. Government funding was discontinued in March 2011. Becta went into liquidation in April 2011</p>	
Australia: NSW	<p>No related policies other than BYOD</p>	

	<i>BYOD in Schools Literature Review 2013</i>	
Australia: special needs students	See Grace, Raghavendra [141]	
Romania	<p>Euro 200: a government program administered by the Romanian Ministry of Education subsidized the purchase of home computers. The program awarded approximately 35,000 vouchers worth 200 Euros (about \$300) in 2008 towards the purchase of a personal computer for low-income students enrolled in Romania's public schools.</p> <p>In the early rounds of the program, the 200 Euro (roughly \$300) subsidy covered a large fraction of the price of a new computer that met the minimum specifications. For example, in 2005, the voucher covered about 75 percent of the price quoted by Romania's largest computer retailer, who sold almost 40 percent of the program's designated computers (ComunicatiiMobile2005). As the price of computers declined overtime, the voucher covered an even higher fraction of the cost. Indeed, by 2007, two of the largest computer retailers were able to offer computers that met the minimum specifications for 200 Euros (Ministry of Education of Romania 2007).</p>	<p>Euro 200 program was intended to increase home computer use among disadvantaged families and promote computer skills for school aged children.</p> <p>A fixed number of vouchers were allocated based on a simple ranking of family income. Malamud and Pop-Eleches [142] used regression analysis estimate the impact of winning a program voucher on computer ownership and use, academic achievement, cognitive skills, computer skills, and various non-cognitive outcomes.</p> <p>Their findings indicate that home computer use has both positive and negative effects on the development of human capital; children in households who won a voucher using computers about 3 to 4 hours a week more than their counterparts who did not win a voucher; children in household who won a voucher had significantly higher scores in a test of computer skills and in self-reported measures of computer fluency, with effect sizes of about 1/4 of a standard deviation.</p> <p>Despite efforts by the government to provide educational software, few parents or children report having educational software installed on their computer, and few children report using the computer for homework or other educational purposes. In contrast, most children report playing computer games on a daily basis.⁹ Furthermore, there is some suggestive evidence that winning a computer voucher reduced the time spent doing homework, watching TV, and reading. These changes in time-allocation may have contributed to lower academic achievement.</p> <p>See Malamud and Pop-Eleches [142]</p>
Uruguay	Plan Ceibal by providing a free OLPC laptop to every primary school child, while other countries, such as Peru	

	and Rwanda, have placed orders for and received hundreds of thousands of computers [143 , 144]	
Peru	<p>1,000 OLPC XO laptops were provided for home use to children attending primary schools in Lima, Peru.</p> <p>See Beurmann, Cristia [9]</p>	<p>The intervention increased access and use of home computers, with some substitution away from computer use outside the home. Children randomized to receive laptops scored about 0.8 standard deviations higher in a test of XO proficiency but showed lower academic effort as reported by teachers. There were no impacts on academic achievement or cognitive skills as measured by the Raven's Progressive Matrices test. Finally, there was little evidence for spillovers within schools.</p> <p>Among students who received XO laptops in grades 3 to 5, 260 students were randomly selected to receive high-speed Internet access at home for five months until the end of the school year in December 2012. An additional 10 training sessions and a manual for Internet use to help students take full advantage of this resource.</p>
Israel	<p>'A Computer for Every Child' was launched in 1996 to provide new computers, software, and PC training for children from disadvantaged communities who did not have a computer at home. For the two decades since, children have had access to computers at home, giving them leverage for achieving equal opportunity and narrowing the digital divide.</p> <p>See Zilka [51], Zilka [145]</p>	
Italy	<p>PolyCultua</p> <p>An initiative to promote children's digital story telling</p>	<p>Participants have three months circa to complete the work. Participants work by themselves, without any form of tutoring. They are provided with a short manual (12 pages) where our own experience with creating stories using 1001 stories is distilled. In order to create the multimedia story, they are given free access to an authoring tool developed by HOC-LAB, 1001stories, a free web service that does not require any software installation.</p> <p>Students' improvement in communication skills and also in "media literacy" (i.e., the ability to decode, understand, and write</p>

		through, and with, all forms of media, in specific with text, audio and images in multimedia form), is quite substantial (fig. 9). Similar results are reported by Xu, Park [146] on the efficacy of digital storytelling to teach writing skills (see also [147] and [148]). A teacher reports: “since texts had to be short and ‘to the point’, students have developed good analysis and synthesis abilities, which in normal school activities are not triggered”.
Hong Kong	In 2011, the Hong Kong government launched a three year pilot scheme on e-learning	[see [131] and [149]]
NZ Digi-OPs	Four local interventions involving a partnership between a group of schools, industry and the Ministry of Education – 2000-2004:	

Appendix 3. Analysis of Educational Value

Academic				
General	P	Agić and Suljić [23] Gunduz [24] So Young, Min-Su[27] Pepe [26] Wong, Ho [25]	Jesson, Meredith [15] Yelland and Neal [34] Araque, Maiden [35] Furlong and Davies [33] Kingston [36]	Oldham Smith [29] Oyaid [30] Sad, Özer [31] Selwyn, Potter [32]
	N	So Young, Min-Su [27]		
	Ne	Erdogdu and Erdogdu [28]	Jewitt and Parashar [37]	
Literacy	P	Casey, Layte [38] Cheung, Mak [39] Hartanto, Toh [40] Johnson [41] Wainer, Vieira [42]	Leu, Forzani [44] McElvain [45]	
	N	Acar Güvendir [43] Johnson [41] Wainer, Vieira [42]		
	Ne			
Math	P	Casey, Layte [38] Hartanto, Toh [40] Reynolds [46] Wainer, Vieira [42] Erdogdu and Erdogdu [28]	Berkowitz, Schaeffer [12]	Nicholas and Fletcher [86]
	N	Wainer, Vieira [42]		
	Ne	Acar Güvendir [43]		
Science	P	Hartanto, Toh [40] Liu and Whitford [47] Wang, Liu [48] Erdogdu and Erdogdu [28]	Dodson [18]	
	N	Akyol, Sungur [49]		
	Ne			

Digital competencies	P	Wong, Ho [25] Duarte, Cazelli [20] Chen, Lin [58]	Jara, Claro [55] Lim [56]	ICT skills Khasawneh and Al-Awidi [54] Kolikant [50] Oyaid [30] Sad, Özer [31] Zilka [51] Lu, Hao [52] Yapici [53]
	N			
	Ne	Li and Ranieri [59] Wu, Chen [61] van Deursen and Van Diepen [60]	Beuermann, Cristia [62]	
Homework	P		Alshehri [64] Starkey, Sylvester [63] Yelland and Neal [34] Li, Moorman [65]	Oldham Smith [29]
	N			
	Ne		Dodson [18]	
Assessment & Academic communication	P		Park and Choi [68] Starkey, Sylvester [63] Cabiness, Donovan [67]	Yapici [53] Anastasiades, Vitalaki [66]
	N			
	Ne			
Informal learning				
Democracy awareness	Ne	Yildiz and Seferoğlu [71]		
Informal learning	P	Rolleston and Krutikova [69]	Di Blas and Paolini [13] Jewitt and Parashar [37] Yelland and Neal [34] Furlong and Davies [33]	Davies [70]