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# **The history of the global evolution of digitally connected families 1990- 2022**

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## ABSTRACT

This is an historical study of the evolution of the digitally connected families of the world between 1990 and 2022, and their role in growing the world's young being digital. It studies the emergence of a global phenomenon that within several decades transformed the lives and learning of most of the world's young and their families, and yet in 2022 remained largely unseen, unrecognised, and lightly researched or documented. It examines the natural evolution, the magnitude of the transformation, its distinctiveness, the marked global commonalities, the main evolutionary stages, identifies the key features and trends, and flags the likely implications for educators and society at large.

It underscores the importance of studying the digitally connected families as a global social and educational phenomenon in its own right, where the families have charted their own evolution and adopted a mode of growing their children being digital, independent of the schools and governments.

**Keywords:** family; digital; networking; connectivity; education; being digital; mindset; evolution; autonomous; global; commonality leadership; unseen

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## 1. Introduction

In 1990, there was a handful of families globally digitally connected. By 2022, they had naturally evolved to become the norm worldwide.

It is a global phenomenon, as yet largely unseen, that has profoundly impacted the lives, work and learning of families the world over, on trend to be even more impactful, particularly on the education of the young. History points strongly to the digitally connected families being primarily responsible for growing the world's young being digital in the last 25 plus years. Between 1990 and 2022, increasingly connected families took the lead role in educating their children in the everyday use of and learning with the digital and the networks. It is argued that far less the schools, and most assuredly not the governments.

The intention in this paper is to:

- begin examining this phenomenon,
- highlight the magnitude of the transformation, its uniqueness, and the global commonalities,
- note the impact of natural evolution,
- underscore the importance of adapting to accelerating digital transformation and being able to flourish within a mainstream digital society,

- examine the major evolutionary stages,
- identify the key features and trends,
- note key areas for further consideration and research, and
- flag likely implications for educators and society at large.

In 1995, around 0.4% of the world's population had Internet connectivity (Roser, et al., 2023). By the close of 2022, it was estimated around 5.3 billion plus (ITU, 2023), or near two thirds of the world's 8 billion plus population were digitally connected. In 2023, Ericsson reported there were at the end of 2022 6.1 billion unique mobile subscribers (Ericsson, 2023). While industry data collection bodies, the likes of the International Telecommunications Union (ITU), Ericsson, Meeker and Statista acknowledge the challenges of clarifying the actual number of users as distinct from subscriptions, the reality was that by 2022 most families in the developed and developing world and a significant number in the underdeveloped world were digitally connected and naturally growing being digital. Those with the money, regardless of where they lived in the world, were connected.

By 2022, 85% plus of the world had access to a 4G broadband network (ITU, 2023), on trend for near universal connectivity within the decade. The world had moved in less than 30 years from being analogue to digital, transitioned from paper to the screen and had become connected, as had its families. In early 2020, at the outbreak of Covid-19, around 90% of students in the developed world were able to undertake their schooling wholly online. The children had the digital devices, the broadband connectivity and critically had grown being digital to the extent that they could readily participate in the virtual schooling. The figures within the developing and underdeveloped world would have been less, but of note is the UNICEF suggestion that two thirds of the world's young were digitally connected in 2017 (UNICEF, 2017).

At the same time as the world was being connected, 50 plus years of Moore's Law and the exponential growth in the power of computer processors was profoundly impacting most facets of life, work and learning, combining with the near universal connectivity to fundamentally change most of the workings of humanity (Cascio & Montealegre, 2016; UN, 2023).

A period that opened in 1990 with immature digital technologies and rudimentary networks closed in 2022 with the use of the digital and networks being normalised worldwide, about to experience the widespread use of artificial intelligence (AI) and reap the benefits of the surge in the use of communication satellites.

The families of the young, like most others, understood the world, in going digital, would naturally and irrevocably evolve at an accelerating rate, likely forever, and that children must be readied to thrive in that world. The message for all was that:

- the digital evolution, and the associated flow on effects can never be stopped, only shaped, regardless of how much people or governments disagree with the change,

- governments, no matter how powerful, cannot stop the evolutionary process,
- the evolution would continue to transform the world's organisations and shift them inexorably to a more networked, and interconnected mode (Lipnack & Stamps, 1994),
- to live in mainstream digital society all citizens, young and old, must be connected and continually grow being digital by using the desired current technologies,
- families will pursue their interests, while government's theirs, with the two sometimes coinciding,
- individuals and organisations that chose to opt out of the digital evolutionary process, and/or which lack the organisational agility to evolve in consonance with societal expectations, will increasingly lag the societal norms and in time become marginalised,
- there always have been, and always will be, some in society who will prey on others, and
- history affirms every new major technological development has in time required operational guidelines.

The messages were understood by many families of the young from the early 1990s. They believed their children's life chances would be enhanced by being connected to the Internet and having a computer, free to use the technology largely as desired. Many parents of the world bought the technologies. Governments provided little or no financial assistance, even for the digitally disadvantaged families until the Blair Government's Home Access Programme in the United Kingdom (UK) in the late 2000s (Tolley, 2010), and even then, it was short-lived and largely not replicated until after the Covid-19 experience.

The families in giving their children the technologies choose to give them the same kind of agency that parents had given teenagers since the 1960s. Very quickly, the young largely took charge of their use of and learning with those tools. Tellingly, while families worldwide charted their own course and evolution, and decided what was best for them, they appeared to all have adopted much the same approach. As did the young. In taking advantage of the agency given and deciding how they would use the Internet and computers, they quickly grew a remarkably common set of attributes and competencies, while also developing a distinct set of individual strengths and competencies that enabled them to pursue in depth their particular interests.

Tapscott and his colleagues in 1998 (Tapscott, 1998), just five years after the launch of the Internet, were able to identify the universal traits of what they termed the Net Generation. The connected families of the world grew increasingly powerful, sophisticated and supportive home digital learning cultures of the type that Seymour Papert (1996) had suggested were critical to naturally growing the young being digital. In acquiring the computer/s, connectivity and emerging technologies, in trusting and empowering the young, in observing and supporting their children's largely unfettered use and learning with the digital families the world over created very powerful natural learning environments.

By 2008 to 2009, those digital home learning environments had become the norm across the developed, and increasingly the developing world.

## 2. Digitally connected families

In 2008, the Pew Internet team of Wellman, Smith, Wells and Kennedy used the term ‘networked families’ to describe what had emerged. Their United States (US) research revealed:

Most households have the internet and cell phones and use them actively. These are family technologies, as almost all married families with children are now internet and cell phone users. Their proportion of use is much higher than that of singles, single-person households and even married couples without children. Despite fears that technology use might pull families apart, American families still lead connected lives, and the more people in their households, the more coordination *and* communication they need. (Wellman, et al., 2008, p. 29)

The indicators suggest, as detailed as follows, this is what had occurred in most digitally connected homes regardless of where they were in the world. Significantly, the snapshot of the situation as the research of Wellman et al. showed in a developed nation did not attempt to define the term. Rather, it detailed the key elements.

Papert, writing in 1996 on the desirability of creating an apt home digital learning culture, wrote of ‘the connected family’ (Papert, 1996).

The authors of this paper, like others, saw the term ‘networked families’ as missing several vital elements, such as the word ‘digital’ and the many messages it communicates and ‘connected’, and thus chose to use the term digitally connected families.

Digitally connected families are those with digital connectivity that have normalised the use of the digital and the networks. In examining their evolution over the period, the importance of the digital element, the connectivity and the family organisational units grew, as did their intertwining and the synergies that arose. A critical facet of the term is its dynamic nature and its continually evolving form, with the digitally connected families of 2000 being very different entities to those of 2022, with those in 2023 on trend to be even more different.

## 3. Being digital

In 1996, Nicholas Negroponte, a colleague of Seymour Papert at MIT, wrote his seminal work on the world ‘*Being Digital*’. His belief was:

Being digital is the license to grow. (Negroponte, 1995, p. 41)

In being digital I am *me*, not a statistical subset. (Negroponte, 1995, p. 164)

In using the digital, in growing the competencies to use those technologies, living and wanting to thrive within a digital environment and having the agency to use the technology to pursue one’s interests and passions,

Negroponete (1995) contended that all will naturally grow being digital. His contended that they will grow an ever stronger shaping digital mindset, a rising set of digital expectations, their values, the desired digital competencies, an awareness of the digital pitfalls, learn how to learn with the digital, to individualise their learning, creative endeavours, and entertainment, and do so lifelong.

It would matter not where one lived in the world, provided there was network connectivity. That is what appears to have occurred with the 5.3 billion plus digitally connected at the end of 2022.

Being digital is different. We are not waiting on an invention. It is here. It is now. It is almost generic in its nature, in that each generation will become more digital than the preceding one. (Negroponete, 1995, p. 231)

Negroponete's second observation is also important. In growing being digital, having the agency to take charge of their use and learning with the digital, the 5.3 billion plus individualised their learning, with each person deciding what they would learn and at what depth. The individual, not the state, made the choice.

The nature of being digital is dynamic, continually evolving throughout life, being shaped by the continued evolution of society. In talking about the young, and indeed the world's population growing being digital, we are using the term in the same way as Negroponete. It is appreciated there are variants of term, and that the expression is particularly used within the business management literature to refer to the nature of organisations and to the staff therein. Central to all, however, is the shaping digital mindset and the apt, all-pervasive use of the digital and networking.

## 4. Digital mindset

KPMG, the international business management corporation, in promoting its Digital Mindset Framework and assessment programme argued that:

This digital mindset must be evident across the workforce, and at the heart of the organisation in these times of continuing and extraordinary technological advances. (KPMG, 2023)

While directed at businesses the thinking holds equally with the family unit. In the growing of the young, and indeed all the digitally connected, the development of a digital way of thinking has seemingly been as important as the growth of the technological capability.

## 5. Core features of the digitally connected families

In examining the evolution of the digitally connected families between 1990 and 2022, and observing the similarities the world over, the following attributes emerged. All bear consideration in the analysis of the four evolutionary stages and the implications that flow for the education of the young:

- Families as small, autonomous, highly agile units, in control of their own monies, legally responsible for the upbringing of their children have few constraints impacting their continued rapid evolution.
- Families in democracies have considerable electoral power that has seen few, if any governments interfere in their affairs or the educational tools or environment that parents have provided their children.
- The digitally connected families have from the outset in the early 1990s placed a high priority on being digital, of being proactive, positive and using the current digital technologies while always being wary of the pitfalls and the dangers.
- Families the world over have funded their digital evolution and the growing of their children and themselves being digital.
- Parents have in many cases trusted and empowered their children to use the digital astutely and given them the freedom to use and learn with the digital largely unfettered.
- From the advent of the Internet, the digitally connected young have, likely for the first time in history, been able to directly access much of the desired information online without going through an adult gatekeeper.
- Families globally with connectivity have charted their own digital evolution, doing what they believe is best for their children and family, on course to continue doing so in most situations in democratic states regardless of what schools or governments might want. There is little in democratic nations to suggest families' use of the digital and the networks since 1990 has been significantly impacted by government or schools, except where governments have changed the need for digital transactions rather than those being paper-based or face-to-face.
- The global evolution of digitally connected families, and emergence of the common features worldwide, would appear to have been predominantly natural and unplanned, a flow on from the disruption and seeming chaos generated by the world going digital and being connected (Pascale, Millemann & Gioja, 2000).
- It is likely most families did not recognise their evolution as a digitally connected family, the global commonalities, their lead in growing their children being digital or the wider implications of the evolution.
- Families globally adopted from the early use of computers onwards a strongly informal *laissez-faire*, constructivist mode of learning with the digital, that stood in marked contrast to the formal, structured, linear approach used by schools. Papert wrote in 1996 of the 'home-style learning' and 'school style learning' (Papert, 1996). With the *laissez-faire*, as the name implies, the family members largely took charge of their use and learning with the technologies, each deciding what they would learn.
- The approach to learning with the digital was based, likely unwittingly, on a different set of assumptions to those that underpinned teaching with the digital in schools. Tellingly, the assumptions were intended to enable the young to grow being digital the moment desired, just in time, in context, anywhere anytime 24/7/365, lifelong. Inherent was the assumption that learning with the digital would need to occur day in and day out, from birth to death. Moreover, the learning would need to be individualised, and evolve in nature throughout life. Serendipitously, by the period's close and the 50<sup>th</sup> year anniversary of the Faure report, *Learning to Be* (Faure, et al., 1972), lifelong learning had become critical for all citizens 0 to 100 years plus.

- The young, like their parents, seemingly did not use any formal assessment tools in growing being digital, rather they adjudged their own capabilities and decided when they needed to up their skills or understanding.
- The 0-5-year-olds in connected families appear to have begun growing digital from birth from around 2010 onwards, competent in the use of touch screen devices by three years, and began school being digital.
- Approximately 20-25% of the annual learning time of those 5-18 years of age was spent in formal learning. The remaining 75-80% of the time was theirs to use.
- For the past 30 plus years, school age members of the family have experienced two modes of learning with the digital, that of the family and that of the school. Invariably, the two modes ran in parallel, with only the exceptional schools willing to genuinely collaborate with their families and recognise the out-of-school learning with the digital.
- The authors of this paper had difficulty finding any concerted programmes, initiated by the parents or governments, designed to grow in the home setting the children's values or ethical use of and learning with the digital. Experience would suggest if done it would have been done by the parents.
- The connected families since the 1990s have used current digital technologies, services and applications, continually updating, with their buying shaped by the market.
- Over the last 25 plus years, the digitally connected families have created, likely unwittingly increasingly powerful, sophisticated and integrated family digital ecosystems, that invariably surpass the capability of those in the classrooms.
- By the close of the period, many digitally connected families of the young had the resources and competencies to school their own children if they desired.

## **6. Core features of the government and school approach to using and learning with the digital**

While the focus of this paper is the evolution of digitally connected families between 1990 and 2022, it is important to contrast their success in growing the world's young being digital with the limited impact of the bodies and agencies charged and funded to perform that role: the schools. A Google search by the authors at the end of 2022 struggled to find a government or a school that had prioritised the growth of the student's digital mindset, or some variant of that wording. The focus of governments and most schools continued, until to the end of the period, to be on the basics, and success in paper-based examinations that assess academic knowledge.

A further Google search for 'national plans to provide digital connectivity for all citizens' revealed, in the likes of Australia, Canada, Ireland, New Zealand, Serbia, Spain and the USA, the emergence late in the period of aspirational plans but few governments that had in place a comprehensive strategy to ready all its citizens, including the disadvantaged to thrive in the mainstream of a digital and networked society.

On the other hand, the search undertaken on 'the dangers of the Internet' yielded 229,000,000 references! Those millions of entries point to years of governments worldwide focussing on the negatives of digitisation,



being reactive, unwilling to play a lead role in assisting to ready all for a digitally connected world. The latter was particularly apparent, as discussed as follows in government lack of support for those families without apt connectivity. The dangers of the digital divide were powerfully expressed at the outset of the world going digital and networked (Tapscott, 1996, 1998). Post the Covid-19 experience and the plight of the unconnected during that period, the majority of governments by the end of 2022 had still to support the marginalised.

The reasons for the limited impact of the schools between 1990 and 2022 would appear to lie partly in the schools' and governments' choices and partly the structural challenges that schools as large public institutions had daily to contend. A sample of both should suffice to make the point:

- Since the 1970s the assumption has been that schools are best placed to educate the young in the use of the digital.
- The trillions of dollars spent by governments globally on digital education has been allocated almost wholly to the schools and teacher education.
- It was moreover assumed that the education would best be provided by those expert in the teaching of the digital, using the traditional formal, structured linear mode of teaching.
- The state, through its syllabus experts and examinations agencies, was best placed to decide what every student would learn, when, how and for how many hours per week. Moreover, the belief has been that all students, the mass, must be taught the same thing. The state would also decide what would not be taught.
- The digital instructional programmes were snapshots in time as perceived by experts, with the focus on the aging image. They were invariably based on the concept of teaching a novice to become an expert. They assumed students entered the course knowing nothing about the digital and after X hours of teaching per week for 6, 10, or 12 years, and passing a test that assessed their knowledge of content matter, decided upon years before they had become digital experts.
- The traditional syllabus development process, with its expert working committee, formal approval process and teacher training ensures the instructional programme is dated by the time it is introduced. Ten-year usage cycles are not uncommon. That might be appropriate with a history or language programme, but with the digital a 2009 syllabus will be dated and largely irrelevant.
- Schools were for serious learning. The focus throughout the period in schools was on using the digital to enhance academic performance, to study programming, and rarely if ever on the young's everyday use of the digital.
- The seemingly unquestioned assumption has been that students not only had to be regularly assessed to learn with the digital but also to be continually ranked. Allied has been the belief that only in-school learning matters and that there should be no formal recognition of prior or out-of-school learning with the digital.
- The belief from the 1990s, from governments and most schools, was that the use of the digital and the networks must be tightly controlled and managed, implying students be distrusted and disempowered, and their every use of the keyboard monitored. The authors' years in teaching, educational administration and consultancy points to schools globally mandating that a teacher had always to be present for students to use

the digital. In mid 2023, UNESCO released a discussion paper suggesting cellphones be banned in schools (UNESCO, 2023).

- Allied was the assumption that all digital learning must be planned, with defined desired outcomes, that had to be regularly assessed.
- The experts, not the market, should decide what devices and software were educationally appropriate, what brands, operating systems, models, applications should be bought and how devices would be configured and maintained. They would also decide what technologies and services should be banned.
- Significantly, while there have been major exceptions in the schools that chose to go the bring your own technologies (BYOT) route, in the authors' experiences most schools insisted they buy their own devices and applications and ban the use of the students' (Lee and Levins, 2012).
- Internet access has from the 1990s been tightly controlled and censored, with the school and/or system deciding what online resources could be used, and teachers controlling when the Internet could be accessed.
- Organisationally, schools have since their standardisation around 1920 struggled to evolve at pace. As large, public institutions controlled by the government of the day, constrained by legislation, the law, legal precedents, funding, bureaucrats, buying and accountability procedures, enterprise agreements, culture, societal expectations and the electorate, they are highly inflexible organisations on trend to increasingly lag the wider societal and workplace use of the digital and networking.
- Schools, throughout a period of accelerating digital transformation, have had to contend with seemingly increasing risk and to opt out of doing anything the principal, educational administrators and/or ministers of education considered contentious. Many schools remained strongly risk averse.
- The legislation governing the workings of schools was invariably written for a physical place called school, that limited their remit to within the schools' walls and hours.

The combination of these factors, coupled often with local constraints, placed major constraints even on the exceptional schools that had normalised the school-wide use of the digital and created digital learning environments. Few, if any, had the freedom or agility of the families, with the trend being for the schools to lag ever further behind their families.

## 7. Historical analysis

History provides the global perspective and the facility to identify major attributes, trends, and likely implications, particularly when examining a dynamic, rapidly evolving global phenomenon like digitally connected families. While detailed snapshots in time are important, they are, in an area of development like this, invariably dated before publication. History continually affirms the dangers of extrapolating from discrete studies and the importance of using a number over time to identify trends. Historical overviews also have the benefit of identifying the big picture and the implications that need to be more fully researched. That is very much the case with recent analyses like this, where there are so many areas that have yet to be researched. The limited published information on the growth of values, ethics and morals has, for example, obliged leaving that

vital area to future research. The dearth of research in many areas has skewed this analysis towards developments with the technology and its use. It has also meant there is greater coverage of those parts of the world where the data have been collected and published.

In employing a historical perspective, it became apparent that nearly all of the literature and research on the evolution of digitally connected families, by the likes of Negroponce (1995), Papert (1995), Tapscott (1998), Green and Hannon (2007), Becta (2007), Becta (2009), Ito and her colleagues (2013), Boyd (2014) and the authors of this paper (Lee & Levins, 2012) focussed on using the developments in families to argue for a more networked mode of schooling. Even the large US research bodies like Pew Internet and Project Tomorrow had in their decades of research on the impact of the digital and networks on learning concentrated on bringing change in the schools. In 2022, a Pew study (Anderson, et al., 2022) wrote of the ‘homework gap’ as if the school learning was the only learning that mattered. Few examined the digitally connected families as a global phenomenon in its own right, that evolved at pace, regardless of what governments or schools desired.

## **8. Networks, connectivity, and networking**

Critical to the evolution of the digitally connected families worldwide has been the networks, inexpensive connectivity and the learning associated with social networking.

Qualcomm, the multinational semiconductor and Wi-Fi technology manufacturer, took as its motto:

Lives are changed when people connect. Life is changed when everything is connected. (Qualcomm, 2023)

Friedman noted:

between 2000 and 2007 we entered a world where connectivity was fast, free, easy for you and ubiquitous. (Friedman, 2017, p. 93)

And significantly on course to being universal.

For a century plus, educators have looked to the device, to the instructional technologies, and in the last 30 plus years to an array of digital devices to revolutionise the education of the young (Lee & Winzenried, 2009). Invariably, the authors of this paper would argue that they have had limited impact. While the devices have been important, likely none have impacted the growth of the digitally connected families as much as the networks, the connectivity, the digital convergence, and the learning that flows from social networking.

While Gordon Moore (Wikipedia, 2023, Moore’s Law) astutely postulated a law on the exponential growth of processing power in the devices, Robert Metcalfe did so with networking, contending that a network’s value is proportional to the square of the number of nodes in the network (Wikipedia, 2023, Metcalfe’s Law). When

one considers the multiplier effect of individuals having several social and other media connections, as well as several devices, those nodes by 2022 would have been in the trillions.

## 9. Global evolution

Implicit in this study is the assumption that the evolution of digitally connected families has been and will continue to be a global phenomenon impacting all digitally connected. Lim observed in 2018 that:

The digitally connected family, was virtually a mainstay in Western urban societies and strongly emerging in urban areas of the Global South with rising internet access. (Lim, 2018, p. 32)

The available research and the ease with which the digital and the networks transcend physical boundaries prompts the authors of this paper to question the limitations of Lim's observation.

As indicated, the ITU noted in 2022 that 85% plus of the world's people had access to the networked world (ITU, 2023). The Ericsson Mobility Report noted that at the end of 2022 there were 8.4 billion mobile subscribers (Ericsson, 2023), more than the world's total population.

One of the benefits of video streaming is the insights it provides into the workings of families worldwide. In 2022, digitally connected families were the norm in shows from Germany, South Korea, Mexico, Argentina, South Africa, and Australia, with the use of the digital so normalised as to be invisible (Statista, 2023a).

Notwithstanding it is important to bear Lim's observation in mind. In examining the global evolution of digitally connected families, while it is important to consider the situation in the developed, developing and underdeveloped world, the reality is that from the advent of the Internet any family that had a telephone line and electricity, wherever they were in the world, has likely evolved as a digitally connected family. Whether they were a middle-class family in England, Brazil, Argentina or India, if they had the monies and connectivity, logic would suggest they would have evolved and grown their children being digital.

We posit that there were four main stages pre-2023:

- 1990–2000. Families and The Net Generation.
- 2000–2009. Digitally Connected Families.
- 2010–Early 2020. Being Digital and Networked.
- 2020–2022. The Covid-19 Experience.

### 9.1 Stage 1. 1990–2000. Families and The Net Generation

This stage opens with the first tentative moves with networking, the early use of email and the awareness that the Super Information Highway was soon to be opened. It closes with the launch of Google and the arrival of inexpensive mobile technology that all in the family, but particularly the teens, would embrace. Teens

worldwide were seen to accelerate from zero to being a Net Generation in the space of four to five years, and their families become even more digital, connected, and networked (Junco & Mastrodicasa, 2007).

It also revealed the attributes that would characterise the evolution of digitally connected families globally, their emergence as networked organisational units and their children's use of and learning with the digital and the networks.

The development occurred seemingly globally, naturally, informally, and unplanned as the world adapted its ways to the rapid, seemingly chaotic digital evolution and transformation. Educationally, it saw, as we detail as follows, the teens' use of the same informal method of learning with the digital and the Internet as they had employed since at least the 1950s in using emerging consumer electronics. Fundamental to the change was the rapid shift from analogue to digital devices, the advent of the Internet and an accelerating digital convergence. In 1990, the homes of the young were telecommunications deserts. The relative few that had computers invariably used stand-alone desktops, with connectivity through slow, expensive 56K telephone lines. But all that changed rapidly with the release of Mosaic in 1993, the free availability of the World Wide Web (WWW), the emergence of internet service providers (ISPs), the growth of web browsers, the swift adoption of free email, the creation of online meeting places and the idealism of a generation who believed the Net would democratise humanity.

For many, the shaping idealism was infectious. By 1998, Tapscott and his colleagues (Tapscott, 1998) spoke of the Net Generation and had identified the universal traits that teens had rapidly and naturally developed in their use of the Internet. Significantly, the predominant digital usage at this stage was by male teens (Tapscott, 1998), with the parents often being digitally unaware or naïve, and the teenage girls and the primary age disinclined to use the technologically immature desktop computers and search facilities. The 56k lines limited the home usage to text, data, and low-resolution graphics.

The second half of the period saw a pronounced shift away from discrete analogue devices to digital variants and a surge in the use of digital and video cameras, MP3 players and games consoles.

In 1992, Perelman made the, then telling, observation that most using personal computers learnt by using the technology and discovering what was possible, and that few acquired the understanding in a formal learning setting. By the turn of the century, it was obvious that the 350 million digitally connected (ITU, 2011) had done just that.

Parent surveys, by the likes of the IDC, Pew Internet and in time the various national communications authorities, revealed from the mid-1990s onwards that the vast majority of parents believed it was vital for their children's life chances to have a computer and Internet access. The Pew Internet finding of 2001 was typical:

87% of parents of online teens believe that the Internet helps students with their schoolwork and 93% believe the Internet helps students learn new things. (Simon, Graziano & Lenhart, 2001)

Likely, the strongest indicators of the parents' views were that the parents of the young led the uptake of the Internet globally (Lee & Finger, 2010; Lee & Levins, 2010) and their purchase, indeed continued purchase, of the children's and family's digital technologies. Throughout this period, and indeed in the three other evolutionary stages, the parents not only bought the devices, connectivity, software and extensive digital home communications and entertainment technologies, but gave the children the agency to use them largely unfettered.

While concerned about the unknown technology, parents globally on balance bought the kit. The parents appear to have trusted their children. They empowered them to use the technology largely as desired, while quietly monitoring the use, in the same ways parents had done for decades.

It was, as indicated, invariably an informal, laissez-faire, discovery-based mode of learning, where the young decided what technology they would use, how, when, and where. Individuals decided what they would learn, how they would learn and at what depth each pursued their interests and passions. The learning was invariably in context, just in time and unstructured. The learning occurred as part of everyday life. As such, the learning was unbounded, unbridled by the traditional academic divisions.

Much of the learning came as indicated in the social use of technology, in the everyday networking with others, and in growing the competencies needed to best use the emerging opportunities. There was seemingly no use made of formal assessment. Individuals adjudged when they needed to improve their capabilities. The chosen mode of learning was impacted by the situation, particularly as the technology and the online resources became more sophisticated and intuitive. Like all others using the digital, the initial inclination was to search for the answer by oneself, then with the help of the technology and, if truly challenging, with the help of one's family, peers, networks or providers.

It was an approach the young found highly attractive. That attraction was evident globally with nearly all during all four stages. The desire by the learner to take charge of their learning, to be trusted, to discover, to innovate, to make immediate use of the technology, was already apparent. As was the recognition that the young often knew more about the digital than the adults:

For the first time ever, in one domain the students will be the teachers and the teachers will be the students. (Tapscott, 1998, p. 37)

The universal commonality of the mindset and a suite of competencies bears underscoring. It was a natural evolutionary development that emerged out of the seeming chaos, not a commonality decided from on high by those in authority.

It was soon apparent that there were two major differences between learning with the analogue and the digital technologies. The first was the impact of digital convergence. The second was the connectivity. The home Internet access, free email, hyperlinks, web browsers, search facilities and the ready facility for networking,

combined with the agency to take charge, provided the young in their homes instant, inexpensive access to all manner of information and resources. Suddenly, ‘cash poor’ teens could freely communicate with their friends globally, socially network and publish to a world audience.

For the first time in human history, the nation’s young did not have to go through formal gatekeepers to access the information desired. The family became the gate keeper, albeit with a very different remit to that of government. It was a development, largely unacknowledged, that irrevocably changed the nature of learning by the world’s young, outside the schools.

At the same time as the teens grew as a Net Generation, so their families better understood the benefits and opportunities of being digitally connected, not only educationally, but also in their everyday lives, work, and personal learning. Digitally naïve parents quickly learnt, often by unwanted experiences, and came to play an increasingly greater role in their children’s learning. Importantly, the parents, like the astute observers, understood that those families without the technology and the connectivity would be disadvantaged. The considerable perils of the digital divide for families, societies at large and the economy were well understood:

What we know for certain is that children without access to the new media will be developmentally disadvantaged. (Tapscott, 1998, p. 7)

## 9.2 Stage 2. 2000–2009. Digitally Connected Families

This stage opens with the teens and their families embracing the new mobile, albeit analogue, technologies, Google and the burgeoning discrete digital devices, and concludes with the demise of Microsoft’s hegemony and the digital convergence enabling the world to use most everyday digital facilities in their hand, with their smartphones.

The potential of the digital and network technology evidenced in the 1990s came to fruition in this stage, with the digitally connected families becoming the new normal, the families strengthening their digital thinking, ecosystem and competencies and likely leading the growth of the nation’s young being digital—albeit unwittingly.

The teens of the world in this period made the digital and networked world their own. Pew Internet, in a significant 2002 study authored by Arafah, Levin, Rainie, and Lenhart, affirmed what many had suspected was happening globally, that:

Many schools and teachers have not yet recognized—much less responded to—the new ways students communicate and access information over the Internet. Students report that there is a substantial disconnect between how they use the Internet for school and how they use the Internet during the school day and under teacher direction. For the most part, students’ educational use of the Internet occurs outside

of the school day, outside of the school building, outside the direction of their teachers. (Arafeh, et al., 2002)

In that use, while most was informal and every-day, the strong impression the world over is that the teens, in particular, adopted a more formal approach to learning in undertaking their school homework. That said, the anecdotal evidence is that as the communications technology evolved, the doing of the homework became more collaborative, often involving several friends.

From the early 2000s, teenage girls joined the boys in normalising the use of the digital and the networks such that by midway through this period the usage was on par, but different. While the girls embraced cellphone use, texting, the creation of blogs and the social media (Lenhart, et al., 2007, 2010) the boys embracement of gaming was greater than most girls. It is a parity and a difference still evident in the Pew Internet study of 2022, although it is of note that while 91% of teenage boys had their own gaming console, so too did 70% of the girls (Vogels, et al., 2022). While much of the research was US-based, the picture painted seemingly aligned with the use by the digitally connected elsewhere.

Leaving aside the exponential impact of both Moore's (Wikipedia, 2023) and Metcalfe's (Wikipedia, 2023) Laws there were a series of key developments that accelerated the uptake of the technology by the young and the families, its normalisation, and the facility to shape much of their learning. While each development is addressed separately, the full impact came from the families embracing all of these in their daily lives.

The first was the advent of inexpensive, 24/7/365, mobile connectivity. The decision, around the turn of the century for mobile/cellphone providers to enable the under 18-year-olds to lease mobile/cellphones changed the scene overnight. Prior to this, telephones had to be bought outright by the parents or those over 18-years-of-age. When coupled with the newly found facility to send inexpensive text/Short Message Service (SMS) messages through multiple telecommunications providers and the availability of inexpensive Nokia and Motorola mobiles, the teens of the world became connected like never before (Campbell, 2005).

By 2005, 45% of those 12-17-year-olds in the US had a cellphone; by 2010, it was 75% (Lenhart, et al., 2010). As stated at the time:

The mobile phone is a status symbol for young people. (Campbell, 2005)

Tellingly, the world's young embraced a unique universal text based language in their everyday usage of the mobile telephones. Pew Internet noted that in 2009 88% of teen cell users texted each day and that one in three sent more than 100 text messages in the day (Lenhart, et al., 2010). While achieved initially with analogue devices operating on analogue networks, the mobiles moved the world's young and their parents irrevocably into low cost, anywhere, anytime connectivity. The International Telecommunications Union (ITU) noted that the volume of global SMS usage grew from 1.7 trillion in 2007 to 6.1 trillion in 2010 (ITU, 2011). That uptake



was markedly assisted by developments in home and community wireless networking, and the ready facility to access the Internet via the mobile or networks.

The second development was the family shift to broadband, be it through improved use of the copper, cable, satellite or by the period's end the digital 3G mobile networks. 2010 saw around two billion globally with Internet connectivity (ITU, 2011).

Another key development at the start of the century was the release of Google's search engine, a facility that very quickly became the world's default facility. Largely unheralded, and of their own choosing, teens worldwide began to use the facilities of the Internet to their own advantage and to use it creatively. Lenhart and her Pew Internet colleagues concluded in 2007:

The use of social media – from blogging to online social networking to creation of all kinds of digital material – is central to many teenagers' lives.

Some 93% of teens use the internet, and more of them than ever are treating it as a venue for social interaction – a place where they can share creations, tell stories, and interact with others. (Lenhart, Madden, Smith & MacGill, 2007)

Significantly, this level of involvement prompted software and device designers to cater more fully for the teenage market. It bears remembering that the imperative of identifying the needs of the users is inherent in the digital design cycle, even if, as Steve Jobs recognised, the market did not yet realise the need for the product or service.

Friendster (2002), MySpace (2003) and Facebook (2006), all free, gave the 13-year-olds plus the ready, inexpensive social networking space and connectivity they desired and the developers the income sought. The global uptake of the services was unparalleled. Facebook, for example, moved from start to 500 million subscribers in the space of four years (Wikipedia, 2023 Facebook).

Wikipedia (2001) and YouTube (2005), again both free, and like the social networking services were in the experience of the authors of this paper invariably blocked by most schools, provided teens a rich and readily accessible self-learning and self-publishing opportunity. YouTube in particular provided the world's teens the facility to use their growing suite of digital tools and competencies to pursue their interests and passions, not only to create their own videos, but instantly publish them to a global audience. By the latter years of this period, teens used the likes of Google, YouTube, Wikipedia, and their peers in marked preference to their teachers (Purcell, et al., 2012).

Four other major fillips to the young growing being digital and social networking were the digital transformation of the world's music industry, the movement of computer gaming online, the continued convergence of the digital devices with the digital networks and the launch of the iPhone and the smartphone

phenomenon in 2007. Steven Job's release of the iPod in October 2001, and the opening of the iTunes store in 2003, transformed the world's music industry and how the young and in turn the world acquired and listened to music. The white iPod headphones and the streaming of music quickly became the way of the young, outside the school walls. By the period's end, Apple had become the largest music store in the world, fundamentally transforming not only the music industry but how the young and their families listened to their music (Wikipedia, 2023, iTunes).

Gaming went online and was networked in this period. Computer gaming became one the world's most popular forms on entertainment rising from around 100 million gamers in 1995 to 2.6 billion in 2017 (Meeker, 2017). The release of the sixth generation games technology in 2000, Grand Theft Auto in 2001, the launch of the Steam Store as the haven for personal computer (PC) gamers in 2003, Xbox 360 in 2005 and Play Station 3 in 2006 took the serious gamers from their home into an internationally networked environment.

In the mid 2000s, the world gained the critical facility to converge the digital devices with digital telephony. It was another largely unheralded game changer. The disparate digital devices receded into niche roles. The roll-out of the 3G digital mobile network, coupled with the early generation smartphones, meant the one device could perform a myriad of functions. Apple capitalised on that facility when in 2007 it released the iPhone. It was soon to transform the world's connectivity, networking, thinking, life, work, learning and entertainment. Users had instant access, in their hand, to all the communications, creative and entertainment facilities that previously existed on separate devices, plus more, as well as high speed networks. Significantly, the iPhone opted for visual, touch-screen controls and the ready facility to load and delete the desired applications, the apps. It largely dispensed with the QWERTY keyboard and the 'hardwiring' of all applications. In so doing it enabled children from as young as two years to readily use the device, spawned a global app development industry, and allowed the users to individualise their iPhone's configuration. Tellingly, it also individualised communication by replacing the numbers with people's names. That individualisation was aided in 2008 by the opening of Apple's App Store, with some 500 apps, rising to some 2.2 million plus by 2017 (Wikipedia, 2023). In a few clicks, users could select the apps they wanted and create a personalised suite of services. Often overlooked, Apple released at the same time the iPod Touch. It provided the very young, and their parents, with a 'safe' and easy entry into the digital and networked world, and to networking under parent supervision. It too was a touch screen device, that had much the same features as the iPhone, but without the telephony. Virtually overnight, all within the digitally connected family had ready mobile access to most of the facilities of the digital and networked world.

While the release of the iPhone was to prove historic and transformative, the initial update of the iPhone technology was only steady (Meeker, 2011). The wider uptake and eventual normalisation of smartphones was aided by Google's release in 2007 of its Android mobile operating system and it being made available to all mobile telephone manufacturers. With Apple focussing on the premium market, the Android variants went

after the total market, providing low cost versions that appealed to the teens and older primary age children, particularly in the developing and underdeveloped world (Meeker, 2011).

Central to all new smartphones was the networked digital camera, not only being able to shoot stills and videos, but to send the images instantly to the Cloud and allow folk to video conference as easily as making a telephone call. This development, when coupled with instant network access, opened the way for the young, their families and significantly e-commerce to use multiple media extensively in their communication, creative endeavours, and sales and to rely less on text only. Often forgotten is that until the printing presses, many written languages, hieroglyphics, Hanzi, Kana, Hanja made extensive use of the pictorial. In many respects, it was the technical limitations of paper and the printing presses that gave prominence to text only written communication (Meeker, 2016). The digital overcame those limitations and allowed the world to supplement, and in many instances, to replace the text with the visual and audio.

By the close of this stage Microsoft's dominance of computing had waned, its efforts with mobiles had failed, and major new technology corporations had usurped the company's once preeminent role. As Steve Jobs noted in 2010, the post-PC era had arrived (Hiner, 2010). By 2010, approximately 2 billion had naturally grown being digital (ITU, 2011) in the manner predicted by Negroponte (1995), and on trend for that number to surge.

### **9.3 Stage 3. 2010–Early 2020. Being Digital and Networked**

This stage opens with families worldwide embracing smartphones, the release of the iPad and an accelerating global broadband connectivity and concludes with the digitally connected families having the digital resources, culture and competencies for their children to do schooling wholly online. In 2010, the latter was impossible, but by the end of this stage, the ability was so readily accepted as to barely rate a comment.

The stage finally sees the young in families grow being digital, their lives being shaped increasingly by a digital and networked mindset, the home digital learning culture and ecosystem strengthened, and the connectivity improved. As a result, increasingly families very much take the lead in educating the children and themselves in the everyday use of and learning with the digital and social networking; albeit still unrecognised.

It also sees digital convergence accelerate, integrating all manner of family activities, increasing interconnectedness, efficiencies, synergies, and learning possibilities. Critically, pre-teens joined their older siblings in normalising the use of the digital and doing so from the first years of life. The young born into digitally connected families after 2010 likely grew being digital from birth onwards (Lev, et al., 2018) using the same informal laissez-faire approach as the rest of the family. It saw near two thirds of the world's young, in the developed, developing and underdeveloped worlds (UNESCO, 2017) move from tinkering with the digital to being digital and growing the mindset and the competencies needed to thrive in a networked society. And it did so in four to five years with scarcely any support from government or schools. It was a global transformation that happened at pace.

That transformation can be primarily attributed to one key technological breakthrough, the release of the iPad in the mid-2010s, but it was supported by five other crucial developments. The iPad provided all, but particularly the very young, with a simple to use, image-controlled, highly reliable, attractive, inexpensive, smart, highly sophisticated mobile device they could make their own. As indicated within a few years, the world's pre-teens moved from dabbling with computers to over 90% of those aged 4-7 years in the developed world owning or having ready access to, and being competent with tablets (Johansen et al., 2016; Rideout, 2014, 2017).

Families worldwide of their own choosing literally bought millions upon millions of touchscreen tablets (Meeker, 2014). The world had never witnessed such a vast and rapid technological uptake (Meeker, 2017), nor an age cohort become so proficient in its use so rapidly.

Importantly, studies by early childhood researchers like Chaudron and her European Commission colleagues (Chaudron, 2015) found children as young as three years adopting the same approach to learning with the digital as the teens in the 1990s. The European studies are significant in that they affirm that eleven European nations naturally employed the same informal learning approach and developed the same core competencies; seemingly, the same as those that had been adopted globally.

The same study affirms what parents and grandparents have long noted, that children grew being digital by playing with the devices, by being innately curious, by taking charge of their own learning, wanting to self-discover and loving what they were doing.

The second crucial development was the digital broadband networking of the world. In 2010, there were around two billion Internet users (ITU, 2011). By 2020, it was five billion plus. However, not only did the broadband connectivity increase, become digital and spread, but so too did the bandwidth, sophistication, and capability. By 2022, when the 3G and 4G network coverage is combined, 95% of the world population had access to a mobile broadband network (ITU, 2022). Video traffic soared in this period (Ericsson, 2017).

The third development was in communications technologies, with the options widening, the technology becoming increasingly sophisticated, visual, simple to use and from the young's perspective, inexpensive. The developments in video conferencing and messaging further accelerated the shift to multiple media, and particularly visual communication. Nearly all the mainstream videoconferencing was free, easy to use, with families being able to choose the likes of Skype (2003), WhatsApp (2009), FaceTime Messenger (2010), Line (2011) and Zoom (2013). At the same time, there was an associated plunge in the use and price of traditional telephony, with it virtually free by the period's end. The traditional home telephone and the young's long-cherished public telephone booths disappearing or hosting free Wi-Fi.

The ease of communications was further assisted by the emergence of wearables and particularly smart watches like the Apple Watch (2015). Importantly, and often forgotten, the smartphones and tablets gave

families, but particularly the young, immensely powerful, sophisticated, and relatively inexpensive and easy to use creative devices and publishing tools. An Apple iPhone 5 was used for example to make the feature film *Tangerine* (2015). The young built on the creative work done in the previous stage, producing and publishing to their blogs, YouTube, Facebook, WeChat (2011), Snapchat (2011) and Tik Tok (2016), all manner of videos, recordings, writings, images, and presentations, often in the process demonstrating very high-level digital production capabilities.

Not only did family ecosystems grow, but so too did social networking. Many in the family had their own digital device, usually a suite of devices and apps that they were able to configure to socially network and pursue their own interests and passions.

While at the time of writing the research had yet to be published, experience would suggest the size, nature and usage made of social networks individually and as a family pointed to social networking markedly assisting all in the family grow being digital.

The fourth unheralded revolutionary development was the world's normalisation of apps. While the groundwork had been done in the latter part of the second stage, the global surge occurred in this stage. In 2010–2011, one invariably needed to explain the term. By 2015, apps had become the new normal worldwide. The uptake with Apple's Apps store was replicated in Google's Android variant.

In many respects, the global, and particularly the family embrace of apps, epitomised the world growing naturally, without any great fanfare being digital and networked. By midway through this period, folk of all ages went to the relevant app on their smartphone or tablet for their banking, streaming service, search facility, social network, games, banking, 'newspaper', music, and boarding pass. Ofcom, the UK's media monitor noted that in 2017 48% of those aged 4-7 years were regularly using the YouTube app (Ofcom, 2017).

Another (fifth) vital development was the continued evolution and enhancement of the home digital learning culture. In freely using the family's wi-fi, synched digital entertainment suite, smart televisions (TVs), video and audio streaming services, the plethora of remote devices, sound bars and artificial intelligence (AI) speakers all grew evermore being digital. Smart TVs came on the market around 2010. When coupled with the increased broadband, the agreement in 2012 for the major streaming services to adopt the Dynamic Adaptive Streaming (MPEG-DASH) format and the ready facility to interface the different digital devices and gaming consoles with large screens, homes became immensely powerful and sophisticated digital ecosystems.

While studies by the likes of Ito and her colleagues (Ito, et al., 2013), the early childhood researchers, and the various national agencies provide an important insight into the individualised nature of the learning, the array of interests pursued and the remarkable similarities worldwide, far more research is needed, particularly into the learning of all in the family, its evolutionary nature, the support afforded and the impact on the family culture. The home digital ecosystem said to everyone, young and old, we are living and growing in a dynamic,

rapidly evolving digital and networked home and society, where it is vital that we stay abreast of developments. The annual studies of the family learning environment by bodies like Ofcom and the Australian Communications and Media Authority (ACMA), provide important insights into the culture of this period, the impact of the digital base, digital convergence, the array of technologies used, those favoured by the different ages, genders and cultures, the options available to all members in the family, the potential natural synergies, and the importance of remaining current.

Importantly, over the decade, the price of the core technology dropped as its sophistication grew. The fall in the price of flat-screen TVs and monitors, laptops, desktops, printers, modems, tablets, and smartphones increasingly enabled more families to create sophisticated learning environments.

The sixth development was again largely unnoticed, even in the homes. The stage saw the decades of work on artificial intelligence (AI) take on a more public persona in the family ecosystem. The more obvious developments were the introduction of voice controls like Siri, into the Apple iPhone 4S in 2011, Amazon's Alexa (2014) and Google Assistant (2016). By 2015, both the Apple and Android mobiles, even the cheaper Android units, allowed the young to operate many apps by voice, and to use highly accurate dictation-to-text facilities.

In embracing the digital, networking and the greater individualisation at pace, the corollary was that families abandoned paper, the analogue, and mass communication and entertainment at a similar rate. While the global analysis has yet to be done, all who experienced the transformation will have observed the disappearance or marked decline of newspapers, magazines, letters, handwriting, free-to-air TV, movie theatres, video, photography, and department stores, fixed telephones, and public phone booths.

Very many children born into digitally connected families in this period had only ever known the digital. Increasingly, their parents were those of the Net Generation who also had only ever known a networked world. It should have come as no surprise that parents worldwide handled so well their very young suddenly using mum's smartphone and tablet. Instinctively, they built on and shaped their children's innate curiosity and ease of using the visual controls. By 2014, Meeker's research revealed that 87% of US millennials never went anywhere without their smartphone, while 76% posted an image or video at least once a day (Meeker, 2016). By early 2020, they very much understood the dynamic and accelerating nature of the digital evolution, embraced the new, and expected that much more of the technology.

#### **9.4 Stage 4. 2020–2022. Families—The Covid-19 experience**

This stage begins in early 2020 with the outbreak of the Covid-19 pandemic and concludes with the world returning to some degree of normality after the Covid experience:

The COVID-19 pandemic has led to a sharp uptake in usage of the Internet. For those privileged enough to be connected, the Internet allowed a measure of continuity. However, for others, the pandemic

exacerbated the cost of digital exclusion. (ITU, 2022, p. 1)

Covid-19 stress-tested the digitally connected families of the world like it did every other human organisation. It particularly tested the family's ability to thrive in an increasingly networked world, to make extensive everyday use of the online in a crisis and for those with school age children to collaborate with schools in the online teaching during frequent school shutdowns.

Many digitally connected families in the developed world handled the stress testing of their digital readiness with relative ease. One of the downsides of the lack of government involvement in digitally connected families is the dearth of data. That which is available suggests that around 80% of families digitally connected, particularly in the developed world, were ready digitally to handle the impact of Covid. The ubiquitous use of the digital in the developed world, the fact that 95% of teens had smartphones (Vogels, et al., 2022), 90% plus of the very young had an iPad, that Ofcom found that at the end 2022 97% of UK families with children aged 0-18 years had digital connectivity (Ofcom, 2023) and that a developed city like Christchurch in New Zealand had to provide connectivity for only 6.7% of its student's homes (GCSN, 2020), reinforces that belief.

That said, there was a sizeable group that were not. It is likely around 20% struggled in some way. They ranged from those that had the connectivity but too few devices, those reliant on smartphones and low-end mobile plans for their connectivity, through to those who did not have Internet access. Importantly, Covid-19 underscored the wisdom of families placing high store in growing their children being digital. The approach ensured that the majority of the young were ready attitudinally, socially, technologically and competence-wise to grow and adapt within a rapidly evolving, often uncertain connected world.

When governments worldwide opted to manage life during the pandemic with smartphones, and assumed everyone had connectivity, they were ready. When the same governments closed schools and conducted the schooling online, again they were ready, with many children having the requisite confidence, agility and skills, family support, broadband connectivity, and digital devices.

As the ITU (2022) noted, for most, Covid accelerated the transition of the digitally connected families to an even more networked mode of life, work, and learning. By 2022, those families worldwide were shaping their lives with an ever stronger digital mindset and had normalised the use of the current digital and network technologies. The use had become so normal for many as to be near invisible.

Whereas in the 1990s it was often digitally naïve parents supporting, primarily, teenagers who knew more than them, by the close of this period, parents, like their children, had grown being digital and were well placed to shape the lives and learning of the children. They, like their teenagers, started the day by turning to their smartphone and never going anywhere without it.

In shutting the entertainment venues and limiting physical movement, Covid prompted families to further grow the home digital ecosystem. Most did. The sales of smart TVs, streaming services, tablets, smartphones, apps,

and laptops all jumped (Statista, 2023b).

In many situations during the pandemic, smartphones and the relevant app were the passport for entry to most premises and gatherings. Smartphones had, by 2020, become critical to life, work and learning in networked societies. They organised people's lives, alerted them to breaking news, informed them of overnight communique, set up meetings, let them know what friends were up to, enabled instant connectivity, synched with other devices, carried the Covid digital passport, enabled payments from the digital wallet, shot, edited, archived, and despatched photographs in seconds all from within one's hands. Having a smartphone had become a very high priority. As children moved into their senior primary years, securing one's own smartphone became a virtual rite of passage. While the very young were very content with their tablets, as they aged, so they desired a smartphone (Meeker, 2016).

By 2022, most in the connected families had multiple digital devices, with the teens and older members often having a tablet, a laptop/desktop, a games console and increasingly a wearable as well as other specialist digital devices like sports cameras and Bluetooth headphones (Vogel, et al., 2022).

Technologically, the period saw few major breakthroughs, rather the focus being on refining the existing devices and procedures needed in managing the pandemic. Group videoconferencing facilities received particular attention, as did online retailing, gaming, streaming services, Quick Response (QR) codes, compliance apps and digital passports. There was, however, one largely unseen technological development that had major implications for the continued evolution of digitally connected families: between 2020 and 2022 the number of communications satellites surged from 2105 to 6905 (Statista, 2023c).

In being digital, the young had become highly confident in the use of all manner of existing and emerging technologies, able to work the new, to apply generic operational principles, to self-teach, to collaborate when apt, to select the technologies that enabled them to pursue their interests and passions, and, importantly, knew how to avoid many of the digital pitfalls.

Critically, like the generations of young from the 1990s onwards, they learnt in large by social networking. They likely gave little thought to how the smart, inexpensive technology and parent agency made that possible, the importance of the art of networking in an interconnected world, the myriad of opportunities they had to network, or the many vital people and vocational skills they naturally developed in their everyday networking. They understood the value as social beings of learning with and from others. Networking had become such an integral part of life and learning that few made any mention of its use.

The increasingly sophisticated and networked home learning culture naturally supported its continued growth. To what extent, and in what way, is uncertain, with the research yet to be done. When, however, one reflects on the exponential growth of Metcalfe's law on networking, and its impact since 1993 with 5.3 billion plus users, the level and impact of social networking will have been considerable.



Covid underscored how poorly governments worldwide had for decades failed to heed the many warnings about the digital divide and provide the families in need with the critical home connectivity. It highlighted that many lower socio-economic homes had only one or two devices, low-level broadband or had connectivity only through smartphones. When suddenly all the family were obliged to operate concurrently from home, they struggled. Families without any connectivity were not only shut out of schooling, but of mainstream digital society. The already disadvantaged were further disadvantaged and marginalised.

Most governments immediately recognised the digital divide when shutting the schools down and the political imperative of instantly providing those struggling with connectivity. Globally, they turned to their education departments to provide a solution. The authors of this paper could not find any governments that provided the families in need with the money to tailor a connectivity that suited their situation. Invariably, they opted for a one-size-fits-all Band-Aid solution, handled by the education authorities, that demonstrated a limited understanding of digitally connected families. Seemingly, near all in need were provided with a laptop, temporary connectivity and access to the school's or system's managed teaching packages. When schools returned after the shutdown/s, the kit had invariably to be returned, leaving the families once again shut out.

A few governments recognised the imperative of all the nation's young having family digital connectivity and providing a permanent solution to the equity of digital access. Some, like the US and Australia, allocated funds in their budgets for the families in need to secure connectivity, others provided the schools with the funds to buy connectivity for those in need (Kuykendall, 2022), while some city governments like Boston, USA provided connectivity for every citizen in need, and not just the young. The latter recognised that every citizen in a networked society, young and old, must have the requisite digital connectivity. In 2022, the Boston strategy remained the exception.

While a comprehensive global study has yet to be published, an analysis of a cross-section of the solutions in train at the close of 2022 revealed that most still distrusted and disempowered the families in need, had bureaucrats or schools manage their support and that few sat within a wider, whole of government strategy to connect and grow every citizen being digital. Mostly, governments and schools at the period's end still did not seemingly recognise the global evolution of digitally connected families, their profound impact, influence, and educational leadership, what living within a digital and networked world entailed, nor did they provide any support, even to those marginalised and disadvantaged. The lack of formal recognition of out-of-school learning evident in the 1990s was still apparent in most schools and governments post-Covid. Not surprisingly, digitally connected families in 2022 concentrated on their own families, and charting the evolutionary path that suited them.

## **10. The implications**

The implications that flow from the global evolution of digitally connected families are many and varied, with more likely to become apparent as further analysis of their evolution is undertaken. We have identified and

outlined a few in the following sub-sections.

## 10.1 Distinct core global organisational units

As argued at the outset, the evidence points very strongly to the digitally connected families of the world being the organisational unit primarily responsible for growing the world's young being digital. It could be argued the families also played a major role in growing the 5.3 billion plus connected being digital.

The use of the term 'being digital', as defined at the outset of this paper, is deliberate in that the desire is to always have the shaping digital mindset, traits and competencies needed to live, work and learn lifelong in a rapidly evolving digital and networked society. It also relates to the reality that the nature of being digital will always be individualised and evolve as individuals age, their wants and needs change and they adapt to the changing world. It has also to do with being able to use and learn with the digital the moment desired, in context, anywhere, anytime, 24/7/365, from birth to death.

The last 25 plus years have continually affirmed that the small, autonomous, highly agile family organisational units, in charge of their own monies, legally responsible for their children's education can grow the young being digital 24/7 from birth onwards. For schools, their remit is basically limited to within the school walls, for X hours a week, for those of school age. They have, as indicated moreover, to contend with major legislative, legal and structural constraints even if they were about to change direction and prioritise growing the students being digital.

The history of the connected families highlights six factors key to growing the young and the wider family being digital:

- *Prioritisation.* They have from the 1990s prioritised their children and over time the whole family being digital, always able to make use of the current digital thinking and technologies.
- *Own kit and connectivity.* They soon recognised the imperative of being connected to the Internet, the young having their 'own' device/s, free to configure and use largely as they desired. For thirty plus years, families of the young have bought (and/or strived to buy) the desired kit and the connectivity, with likely few, if any, governments providing the families with funding.
- *Trust and empowerment.* Throughout the period, parents have trusted the children sufficiently to continually buy them current digital technologies and give them freedom to largely take control of the use and learning with the technology.
- *Individualisation.* In the children taking charge of their learning with the digital, in having the agency to decide what to learn, how, when, where, at what depth and with the support of the desired folk and digital tools, the children have not only individualised their growing of being digital but developed as indicated the skills and competencies they, and not the state, desired. The implications of the latter alone are potentially considerable.

- *Informal laissez-faire learning.* The 5.3 billion plus digitally connected at the end of 2022, who had naturally grown being digital, seemingly universally opted for an informal way of learning. They opted for an approach that allowed them to learn the moment desired, in context, anywhere, anytime, 24/7/365 every day of their life.
- *Family digital learning culture.* In embracing the emerging digital technologies, in enjoying the new games consoles, iPod, smart televisions (TVs), streaming services, video conferencing, social networking and the convenience of smartphones, and being daily immersed in a digital environment, the young naturally and likely unwittingly grew their digital prowess.

While recognising the variability of schools the world over and having researched exceptional schools that have collaborated closely with their families (Lee and Ward, 2014) few, if any in the period would likely have incorporated all six variables in their operations. Nor would any have had the freedom to spend their monies and operate free of government interference like the connected families.

Between 1990 and 2022, their evolution fundamentally changed family life worldwide, particularly in families with young, on trend to continue so doing. Critically they did so largely (and to different extents depending on country) without the support of schools or government.

## 10.2 Charting own course

Digitally connected families of the world are on trend to continue charting their own evolution, doing what is best in their eyes for the family and growing being digital using the informal laissez-faire mode of learning, regardless of the desires of schools or government. Observed practices over the last 25 years suggests connected families the world over have not deviated from that approach, with no signs of doing so.

One of the greater challenges for governments, schools and society in general is to accept that digitally connected families are better placed organisationally, socially, educationally, economically, logistically, legally, and politically to grow the nation's young being digital from birth onwards, 24/7/365, than the schools.

## 10.3 Accelerating evolution and power

Over the last 25 plus years the evolution, and educational power of families has accelerated, largely consonant with Moore's Law on computing power and Metcalfe's on networking, on trend for that to continue. The powerful and sophisticated family digital ecosystems and learning cultures of 2022 are on track to become more so, becoming universal, ever more powerful, sophisticated, interconnected, and supportive.

## 10.4 Educational leadership

Each stage in the evolution of the connected families saw them grow their educational leadership of children's everyday use of, and learning with, the digital and the networks. It is likely that most have not recognised their leadership, appreciated they have played the lead role from their children's birth, understood how critical trust,

agency and the largely unfettered use of the devices and instant connectivity have been to the learning, appreciated the importance of a supportive home digital learning culture or understood why so many aspects of learning with the digital and the networks can only occur in the home and not at schools.

That said, neither have most schools and governments, with both continually lauding the learning with the digital they provide. Not only did schools often increasingly lag behind the digital and network use of families, but in focussing for 25 years plus on using the digital for academic learning and micromanaging every aspect of use the schools, relegated themselves to a limited niche role that has had little or no impact on the young's or the family's everyday use. In the latter part of the period, particularly during Covid, most digitally connected families demonstrated the ability, should they desire, to provide a rich, digitally based, and networked schooling for their children, independent of formal schooling.

## **10.5 Global commonality**

The reality that 5.3 billion plus digitally connected people who naturally grew being digital in a remarkably similar way and developed the same kind of mindset and digital competencies has many and varied implications. Governments, their bureaucrats, principals, and educational researchers have invariably worked on the belief that all learning must be planned, with clearly defined outcomes, structured, tightly controlled, and continually measured. By their actions, 5.3 billion plus have questioned that assumption as it relates to growing the total population being digital.

## **10.6 Role within networked society**

By 2022, digitally connected families had become an integral and central part of networked societies worldwide. They were on trend to continually grow their leadership, digital ecosystem, home digital learning culture and their central role in growing most citizens being digital. Moreover, they were on course to still do so without assistance from or recognition by government or schools. Covid-19 underscored the ease with which most were able to accommodate a wholly networked mode of education.

Significantly, it also highlighted the imperative in networked societies of every family member, young and old, being digitally connected. In a world where the paper and analogue services were fast disappearing, the importance of being connected and digital was on trend to grow.

Unless families have apt permanent connectivity, they are unable to evolve as digitally connected families and to partake in mainstream digital society. While the dangers of the digital divide have been expressed for decades, Covid highlighted that most governments placed little or no importance in ensuring that all in society, and particularly the socio-economically disadvantaged and marginalised, had appropriate and permanent digital connectivity. Governments globally need not only to better understand the digitally connected families phenomenon, but to ask what role they should play, particularly with unconnected citizens.

Had the evolutionary stage been reached at the end of 2022, when the question to be asked in all democracies, was: do governments need to be involved at all in the evolution of digitally connected families or is it best left to the families?

## **10.7 Role of schools in growing the young being digital**

With the digitally connected families of the young on trend to increase their role in growing the young being digital and the schools lagging, increasingly questions should be asked, particularly by the likes of productivity bodies and treasuries about the role schools can realistically play, and whether part of the funding provided to schools to fulfill their remit might better be spent elsewhere. In brief, 25 plus years of history should warrant a revisiting of the original assumptions underpinning nearly every nation's efforts to educate its young for a digitally connected society.

## **10.8 Individualisation**

The evolution of the families' approach has seen individual members take charge of their use and learning with the digital. The shift from the mass to the individual (Negroponte, 1995) was clearly evident in 2022. Each took charge of their learning with the digital. From very early in life, they grew an individualised suite of competencies, those they desired, something they would continue to do lifelong as the technologies evolved. The individual made the decisions. In the schools, the state not only made the decisions but also decided how the masses would learn and be tested upon the same material.

What are the implications of this dichotomy?

## **11. Conclusion**

We posit that by 2022, the digitally connected families of the world were primarily responsible for growing humanity's adopting and adapting to the digital world, and that they are on trend to continue to do so.

In a little over two decades, their use of the digital had moved from virtual non-existence to being the new normal worldwide. However, their central role remained largely unseen and unrecognised by governments, schools, the mass media and likely many digitally connected families.

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Mal Lee has had a long career in school education as a teacher, principal, head of a board of studies, director of schools and more recently readying a series of publications for ACER Press on the use and impact of the digital. 50 years ago, Mal was one of the original architects of the new Australian Capital Territory (ACT) education system, dropping the traditional examinations and adopting the school-based curriculum design and assessment still central to ACT schooling. That macro perspective has more recently been applied to studying the evolution globally of digitally connected families.



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## References

- Allen, K. & Rainie, L. (2002). *Parents Online*. Pew Internet. Accessible at: <http://www.pewinternet.org/2002/11/17/parents-online/>
- Anderson, M. (2016). *Parents, Teens, and Digital Monitoring*. Pew Internet. Accessible at: <http://www.pewinternet.org/2016/01/07/parents-teens-and-digital-monitoring/>
- Anderson, M., Faverio, M. & McClain, C. (2022). *How Teens Navigate School During COVID-19*. Pew Internet. Accessible at: <https://www.pewresearch.org/internet/2022/06/02/how-teens-navigate-school-during-covid-19/>
- Arafeh, S., Levin, D., Rainie, L. & Lenhart, A. (2002). *The Digital Disconnect: The widening gap between Internet-savvy students and their school*. Pew Internet. Accessible at: <http://www.pewinternet.org/2002/08/14/the-digital-disconnect-the-widening-gap-between-internet-savvy-students-and-their-schools/>
- Becta. (2007). *Harnessing Technology review 2007: Progress and impact of technology in education, summary report*. Becta. Accessible at: [https://dera.ioe.ac.uk/id/eprint/1425/7/becta\\_2007\\_htreview\\_report\\_Redacted.pdf](https://dera.ioe.ac.uk/id/eprint/1425/7/becta_2007_htreview_report_Redacted.pdf)
- Becta. (2009). *Harnessing Technology Review 2009: The role of technology in education and skills*. Becta. Accessible at: [https://dera.ioe.ac.uk/id/eprint/1422/7/becta\\_2009\\_htreview\\_report\\_Redacted.pdf](https://dera.ioe.ac.uk/id/eprint/1422/7/becta_2009_htreview_report_Redacted.pdf)
- Boyd, D. (2014). *It's Complicated. The social lives of networked teens*. Yale University Press. Accessible at: <http://www.danah.org/itscomplicated>
- Campbell, M. (2005). The impact of the mobile phone on young people's social life. *Paper presented at the Social Change in the 21<sup>st</sup> Century Conference Centre of Social Change Research QUT, 28 October 2005*. Accessible at: <https://eprints.qut.edu.au/3492/1/3492.pdf?q=on-the-mobile-the-effects->
- Cascio, W.F. & Montealegre, R. (2016). How Technology is changing Work and Organisation. *Annual Review of Organizational Psychology and Organizational Behavior*, 3, 349–375. <https://doi.org/10.1146/annurev-orgpsych-041015-062352>
- Chaudron, S. (2015). *Young Children (0-8) and Digital Technology*. European Commission JRC. Accessible at: <http://publications.jrc.ec.europa.eu/repository/handle/JRC93239>
- Deloitte. (2017). *Rewriting the Rules of the Digital Age: Deloitte Global Human Capital Trends*. Deloitte University Press. Accessible at: <https://www2.deloitte.com/au/en/pages/human-capital/articles/global-human->

[capital-trends-2017.html](#)

Educause. (2020). *2020 Educause Horizon Report*. Educause. Accessible at:

<https://www.educause.edu/horizon-report-2020>

Ericsson. (2017). *Ericsson Mobility Report*. Accessible at: <https://www.ericsson.com/assets/local/mobility-report/documents/2017/ericsson-mobility-report-november-2017.pdf>

Ericsson. (2023). *Ericsson Mobility Report*. Accessible at: <https://www.ericsson.com/en/news/2023/2/emr-february-2023-update>

Faure, E., Herrera, F., Kaddoura, A.R., Lopes, H., Petrovsky, A.V., Rahema, M. & Ward, F.C. *Learning to be: the world of education today and tomorrow*. UNESCO. Accessible at:

<https://unesdoc.unesco.org/ark:/48223/pf0000001801>

Friedman, T. (2016). *Thank you for Being Late*. Farrer, Straus Giroux.

Graziano, S. M. & Lenhart, A. (2001). *The Internet and Education*. Pew Internet. 21 Accessible at:

<http://www.pewinternet.org/2001/09/01/the-internet-and-education/>

GCSN. (2020). *Closing the Digital Divide during the COVID-19 Lockdown*. Greater Christchurch Schools' Network Trust. Accessible at: [https://9dce24cd-9dc0-4130-974f-92f95f164beb.usrfiles.com/ugd/9dce24\\_79332a39f2924734856ffa3b5a3ababf.pdf](https://9dce24cd-9dc0-4130-974f-92f95f164beb.usrfiles.com/ugd/9dce24_79332a39f2924734856ffa3b5a3ababf.pdf)

Green, H. & Hannon, C. (2007). *Their Space. Education for a digital generation*. Demos. Accessible at:

<http://www.demos.co.uk/files/Their%20space%20-%20web.pdf>

Hiner, J. (2010). Steve Jobs Proclaims the post PC era has arrived. *TechRepublic*. Accessible at:

<https://www.techrepublic.com/article/steve-jobs-proclaims-the-post-pc-era-has-arrived/>

Ito, M., Horst, H., Bittanti, M., boyd, d., Herr-Stephenson, B., Lange, P.G., Pascoe, C.J. & Robinson, L. (2008). *Living and Learning with New Media; Summary of Findings from the Digital Youth Project*. The John D. and Catherine T. Macarthur Foundation Reports on Digital Media and Learning. Accessible at:

<https://www.macfound.org/press/publications/living-and-learning-with-new-media-summary-of-findings-from-the-digital-youth-project/>

Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., Schor, J., Sefton-Green, J., & Watkins, C. (2013). *Connected Learning: An Agenda for Research and Design*. Digital Media and Learning Research Hub. Accessible at: <https://dmlhub.net/publications/connected-learning-agenda-for-research-and-design/index.html>

[design/index.html](#)



- ITU. (2011). *The World in 2010. The Rise of 3G*. ITU. Accessible at: <https://www.itu.int/ITU-D/ict/facts/2011/material/ICTFactsFigures2010.pdf>
- ITU. (2022). *Statistics*. ITU. Accessible at: <https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx>
- ITU. (2023). *Global Connectivity Report*. ITU. Accessible at: [https://www.itu.int/dms\\_pub/itu-d/opb/ind/D-IND-GLOBAL.01-2022-SUM-PDF-E.pdf](https://www.itu.int/dms_pub/itu-d/opb/ind/D-IND-GLOBAL.01-2022-SUM-PDF-E.pdf)
- Johansen, S. L, Larsen, M.C & Ernst, M.J. (2016). *Young Children and Digital Technology*. Aarhus University, Aalborg University, and the Danish Media Council for Children and Young People.
- Kuykendall, K. (2022). New Data: Nearly Half of Schools Providing Home Internet Access to Students Who Need It This School Year. *The Journal*. Accessible at: <https://thejournal.com/articles/2022/09/27/nearly-half-of-schools-providing-home-internet-access-to-students-who-need-it-this-school-year.aspx>
- Lee, M. & Winzenried, A. (2009). *The Use of Instructional Technology in Schools*. ACER Press.
- Lee, M. & Finger, G. (Eds.). (2010). *Developing a Networked School Community*. ACER Press.
- Lee, M. & Levins, M. (2010). Homes and the digital technology: A home-school difference or divide? In: Lee, M. & Finger, G. (Eds.). *Developing a Networked School Community*. ACER Press.
- Lee, M. & Levins, M. (2012) *Bring Your Own Technology*. ACER Press.
- Lee, M. & Ward, L. (2013) *Collaboration in learning: transcending the classroom walls*. ACER Press.
- Lenhart, A. & Madden, M. (2005). *Teen Content Creators and Consumers*. Pew Internet. Accessible at: <http://www.pewinternet.org/2005/11/02/teen-content-creators-and-consumers/>
- Lenhart, A., Madden, M., Smith, A. & MacGill, A. (2007). *Teens and Social Media*. Pew Internet. Accessible at: <http://www.pewinternet.org/2007/12/19/teens-and-social-media/>
- Lenhart, A., Ling, R., Campbell, S. & Purcell, K. (2010). *Teens and Mobile Phones*. Pew Internet. Accessible at: <https://www.pewresearch.org/internet/2010/04/20/teens-and-mobile-phones/>
- Lenhart, A. (2012). *Teens, Smartphones and Texting*. Pew Internet. Accessible at: <http://www.pewinternet.org/2012/03/19/teens-smartphones-texting/>
- Lev, Y.B., Elias, N. & Levy, S.T. (2018). Development of Infants' Media Habits in the Age of Digital Parenting. In: Mascheroni, G., Ponte, C. & Jorge, A. (Eds.). *Digital Parenting. The Challenges for Families in the Digital Age*. Nordicom. Accessible at: [https://www.nordicom.gu.se/sites/default/files/kapitel-pdf/02\\_lim.pdf](https://www.nordicom.gu.se/sites/default/files/kapitel-pdf/02_lim.pdf)

Lim, S.S. (2018). Transcendent parenting in digitally connected families. In: Mascheroni, G., Ponte, C. & Jorge, A. (Eds.). *Digital Parenting. The Challenges for Families in the Digital Age*. Nordicom. Accessible at: [https://www.nordicom.gu.se/sites/default/files/kapitel-pdf/02\\_lim.pdf](https://www.nordicom.gu.se/sites/default/files/kapitel-pdf/02_lim.pdf)

Junco, R. & Mastrodicasa, J. (2007). *Connecting to the Net Generation: What Higher Education Professionals Need to Know About Today's Students*. NASPA.

Meeker, M. (2011). *Internet Trends 2011*. Kleiner Perkins. Accessible at: <https://www.scribd.com/doc/69309864/KPCB-Internet-Trends-2011#>

Meeker, M. (2014). *Internet Trends, 2014*. Kleiner Perkins. Accessible at: <https://www.kleinerperkins.com/perspectives/2014-internet-trends/>

Meeker, M. (2016). *Internet Trends, 2016*. Kleiner Perkins. Accessible at: <https://www.kleinerperkins.com/perspectives/2016-internet-trends-report/>

Meeker, M. (2017). *Internet Trends 2017*. Kleiner Perkins. Accessible at: <https://www.kleinerperkins.com/perspectives/internet-trends-report-2017/>

Negroponte, N. (1995) *Being Digital*. Hodder and Stoughton.

Ofcom. (2017). *Children and parents: media use and attitudes report*. Ofcom. Accessible at: <https://www.ofcom.org.uk/research-and-data/media-literacy-research/childrens/children-parents-2017>

Ofcom. (2023). *Children and Parents: Media Use and Attitudes*. Ofcom. Accessible at: [https://www.ofcom.org.uk/data/assets/pdf\\_file/0027/255852/childrens-media-use-and-attitudes-report-2023.pdf](https://www.ofcom.org.uk/data/assets/pdf_file/0027/255852/childrens-media-use-and-attitudes-report-2023.pdf)

Papert, S. (1996). *The Connected Family*. Longstreet Press.

Pascale, R.T., Millemann, M., & Gioja, L. (2000) *Surfing at the Edge of Chaos*. Three Rivers Press.

Perelman, L. (1992). *School's Out*. Avon Books.

Project Tomorrow. (2009). *Selected National Findings: Speak Up 2008 for Students, Teachers, Parents and Administrators*. Speak Up/Project Tomorrow. Accessible at: [http://www.tomorrow.org/speakup/pdfs/SU08\\_findings\\_final\\_mar24.pdf](http://www.tomorrow.org/speakup/pdfs/SU08_findings_final_mar24.pdf).

Project Tomorrow. (2010). *Unleashing the Future Educators: 'Speak Up' about the use of Emerging Technologies for Learning*. Project Tomorrow. Accessible at: <http://www.tomorrow.org/speakup/pdfs/su09UnleashingTheFuture.pdf>

Project Tomorrow. (2011). *The New Three E's of Education: Enabled, Engaged and Empowered*. Accessible at: [http://www.tomorrow.org/speakup/pdfs/SU10\\_3EofEducation\\_Educators.pdf](http://www.tomorrow.org/speakup/pdfs/SU10_3EofEducation_Educators.pdf)

Project Tomorrow. (2011). *The New Three E's of Education: Enabled, Engaged and Empowered*. Project Tomorrow. Accessible at: [http://www.tomorrow.org/speakup/pdfs/SU10\\_3EofEducation\(Students\).pdf](http://www.tomorrow.org/speakup/pdfs/SU10_3EofEducation(Students).pdf)

Project Tomorrow. (2014). *The New digital Learning Playbook: Understanding the Spectrum of Students' Activities and Aspirations*. Project Tomorrow. Accessible at: [http://www.tomorrow.org/speakup/SU13DigitalLearningPlaybook\\_StudentReport.html](http://www.tomorrow.org/speakup/SU13DigitalLearningPlaybook_StudentReport.html)

Purcell, K., Rainie, L., Heaps, A., Buchanan, J., Friedrich, A., Jacklin, A., Chen, C. & Zickuhr, K. (2012). *How Teens Do Research in the Digital World*. Pew Internet. Accessible at: <http://www.pewinternet.org/2012/11/01/how-teens-do-research-in-the-digital-world/>

Roser, M., Ritchie, H. & Ortiz-Ospina, E. (2023). *Internet*. Accessible at: <https://ourworldindata.org/internet>

Schaeffer, K. (2022). *A dwindling number of new US college graduates have a degree in education*. Pew Internet. Accessible at: <https://www.pewresearch.org/fact-tank/2022/09/27/a-dwindling-number-of-new-u-s-college-graduates-have-a-degree-in-education/>

Statista. (2023a). *Global share of users watching content via streaming services Q3 2022, by country*. Accessible at: <https://www.statista.com/statistics/1276701/share-internet-users-watching-content-streaming-services-month-worldwide-country/>

Statista. (2023b). *Consumer Electronics – Worldwide*. Statista. Accessible at: <https://www.statista.com/outlook/cmo/consumer-electronics/worldwide>

Statista. (2023c). *Number of active satellites from 1957 to 2022*. Accessible at: <https://www.statista.com/statistics/897719/number-of-active-satellites-by-year/>

Strauss, V. (2020). How relationships between teachers and students are being tested in covid-19 crisis. *Washington Post April 2020*. Accessible at: <https://www.washingtonpost.com/education/2020/04/22/how-relationships-between-teachers-students-are-being-tested-covid-19-crisis/>

Tapscott, D. (1996). *The Digital Economy. Promise and Peril of Networked Intelligence*. McGraw-Hill.

Tapscott, D. (1998). *Growing up digital: The rise of the Net Generation*. McGraw Hill.

Tolley, R. (2010). UK Home Access Plan: A Case Study. In: Lee, M. & Finger, G. (Eds.). *Developing a Networked School Community*. ACER Press.

UNESCO. (2023). *Smartphones in schools? Only when they clearly support learning*. UNESCO. Accessible at: <https://www.unesco.org/en/articles/smartphones-school-only-when-they-clearly-support-learning>

United Nations. (2023). *The Impact of Digital Technologies*. United Nations. Accessible at: <https://www.un.org/en/un75/impact-digital-technologies>

Vogels, E.A, Gelles-Watnick, R. & Massarat, N. (2022). *Teens, Social Media and Technology 2022*. Pew Internet. Accessible at: <https://www.pewresearch.org/internet/2022/08/10/teens-social-media-and-technology-2022/>

Wellman, B., Smith, A., Wells, A. & Kennedy, T. (2008). *Networked Families*. Pew Internet. Accessible at: <http://www.pewinternet.org/2008/10/19/networked-families/>

Wikipedia. (2023). *App Store*. Wikipedia. Accessible at: [https://en.wikipedia.org/wiki/App\\_Store\\_\(iOS/iPadOS\)](https://en.wikipedia.org/wiki/App_Store_(iOS/iPadOS))

Wikipedia. (2023). *History of Facebook*. Wikipedia. Accessible at: [https://en.wikipedia.org/wiki/History\\_of\\_Facebook](https://en.wikipedia.org/wiki/History_of_Facebook)

Wikipedia. (2023). *History of iTunes*. Wikipedia. Accessible at: [https://en.wikipedia.org/wiki/History\\_of\\_iTunes](https://en.wikipedia.org/wiki/History_of_iTunes)

Wikipedia. (2023). *Metcalf's Law*. Wikipedia. Accessible at: [https://en.wikipedia.org/wiki/Metcalf%27s\\_law](https://en.wikipedia.org/wiki/Metcalf%27s_law)

Wikipedia. (2023). *Moore's Law*. Accessible at: [https://en.wikipedia.org/wiki/Moore%27s\\_law](https://en.wikipedia.org/wiki/Moore%27s_law)