40TH PARLIAMENT

Education and Health Standing Committee

Report 8

A BETTER CONNECTED FUTURE

Opportunities for digital innovation in secondary education

Presented by
Ms J.M. Freeman, MLA

November 2019

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Education and Health Standing Committee

A better connected future

Opportunities for digital innovation in secondary education

Report No. 8

Presented by

Ms J.M. Freeman, MLA

Laid on the Table of the Legislative Assembly on 28 November 2019

Inquiry Terms of Reference

The inquiry into Digital Innovation in Secondary Education will consider:

1. How digital innovation can assist secondary students to learn anything, anywhere, anytime
2. The role of digital technology in addressing secondary student engagement and retention
3. How digital innovation can increase equity of opportunity in secondary education
4. The potential for digital technology to cater to the needs of high performers and at-risk learners in secondary education
5. Challenges to implementation, including provision of digital infrastructure, resources and technical support

Chair's Foreword

Digital technology is in our lives and in our classrooms, and schools need support to ensure students make the best use of it. While it would be wrong to suppose that digital technology is the answer to every educational challenge, it would also be negligent to ignore its many benefits.

Throughout this inquiry, we have learnt about educational technologies that bring a dimension to learning that has never been possible before. Students can build a virtual model of the human body and then journey through it using an avatar. They can enter a manual arts workshop in Meekatharra and learn how to do woodwork from a teacher in Perth. They can record their science experiments on iPads, turn their dance moves into music videos, build robotic elephants, and use software that anticipates their learning needs.

It was heartening to see and hear about the enthusiasm of students and their teachers who were accessing these and many other technologies. But it was also sad to realise that not all secondary students have this same opportunity, for a variety of reasons.

As the inquiry progressed, it became apparent that it is critically important for schools to have a vision for the use of digital technology. The Department of Education has still not released a vision statement to guide schools on teaching practices and learning outcomes in regard to digital technology, despite the previous ICT vision statement expiring in 2016. Technology has not waited for a strategy to be in place. It has marched on, and schools, meanwhile, are trying to keep up.

While some schools struggle with resources, teachers with the requisite skills, and ways to integrate digital technologies into the curriculum, the biggest challenges raised during the inquiry related to bandwidth and connectivity. Connecting students in a state as large and sparsely populated as ours is a complex undertaking for the Department, but most schools are now connected to a fibre network.

However, accessing enough bandwidth to be able to offer activities such as virtual work experience or YouTube lessons for multiple users seems to be a problem for many schools. During the inquiry, the Western Australian Government announced an increase to bandwidth for 500 schools, which may mean that some schools will not need to purchase extra internet. We were concerned to discover the wide range of monthly charges for purchased internet services, with some schools paying more than others for the same or smaller bandwidth. We have recommended the Department reviews the contractual arrangements schools are making with internet retail service providers.

We have also made recommendations in regard to ensuring availability of some of the very useful digital technologies which can assist students with special needs, including those who are gifted or are disadvantaged for social or cultural reasons.

Importantly, we have made recommendations regarding the content of the ICT Vision Statement. We hope that it will clearly articulate a method for integrating digital technology into the curriculum, and clearly define a shared goal for students to learn not just *about* but *with* digital technology.

We began this inquiry with the idea of exploring the possibilities of learning anything, anywhere at any time. While the Department of Education asserts that students can already do this, our assessment is that students can learn some things in some places, some of the time. At present there is uneven access to learning with digital technology across public secondary schools. Guidance on implementation and a vision for how to make the best use of digital technology will play an important role in addressing this.

I would like to thank the principals, teachers, students and parents who made time to talk to us and helped us understand the possibilities and the challenges. I would also like to thank my fellow committee members for their contributions and the staff for their assistance throughout the inquiry.

MS J.M. FREEMAN, MLA
CHAIR

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Executive Summary

For three years, schools have been without an Information and Communications Technology (ICT) Vision Statement to guide both ICT infrastructure and the use of digital technologies to assist learning. The Department of Education (DoE) told the Committee in June 2019 that publication of its ICT Vision Statement (an update to the 2014–2016 statement) was imminent, but revised this three months later when it transpired that critical elements such as teaching practices and learning outcomes had not been included. Schools have been left to determine how to make the best use of digital technology, resulting in unsystematic, uneven implementation.

As well as exploring the use of digital technology to provide opportunities to learn from anywhere at any time, this inquiry focussed on how digital technology might help to engage students at secondary school. In addition, the inquiry considered how digital technology can provide a more inclusive and equitable experience for students with disability, with learning difficulties or who are disadvantaged.

It was difficult to ascertain to what degree digital technology is being used across all secondary schools. Beyond some baseline infrastructure and management systems provided by the DoE, most schools seem to have some hardware (such as robotics kits and 3D printers) and software (such as Mathletics and Minecraft).

Engagement, inclusion and equity

The inquiry found that there is wide acceptance that digital technology can increase engagement in learning (and even reduce absenteeism) because it makes learning more enjoyable. Digital technology can also assist students who are disadvantaged for cultural, linguistic and socioeconomic reasons or because of where they live. There are a range of programs (many provided by external organisations) which target Indigenous students, with digital tools found to be particularly compatible with Aboriginal culture and ways of learning. Digital technologies could also expand study options for students from small regional and remote schools, and provide virtual work experience opportunities. Digital technology was seen as a way of keeping students with their families and ensuring the sustainability of small regional communities. While there are tools to assist students with a language background other than English, the Committee is not aware of the extent to which these are being used in secondary schools in Western Australia.

The DoE uses digital technology to keep students who are not attending school for medical reasons connected to their enrolled school. However, it is unclear to what degree students with other learning difficulties (such as dyslexia and giftedness) are being offered tools such as assistive technologies and adaptive courseware. The Committee was told that more families were opting for home schooling because schools were not catering for special needs. While the DoE provides assistive technologies and some professional learning support for students with disability, we do not know to what extent these are being used in the classroom. National reports suggest that they are under-used. The DoE must ensure that assistive technologies are supplied to all students that need them.

Digital strategy

In October the WA Government announced it would increase bandwidth to more than 500 public schools, recognising that a fast and reliable internet connection underpins access to a range of educational digital technologies. Almost all schools are now connected to the internet by way of a fibre connection. However, maintaining connections to all schools across the state is challenging. The DoE has committed to providing 100 kilobits per second per user (location and infrastructure complications permitting) by term three 2020, but the DoE should review this target given higher bandwidth per user targets in some other Australian jurisdictions.

Almost one-third of secondary schools have taken up the School Managed Internet program, which allows them to supplement the bandwidth provided by the department with a purchased service. There is wide variation in the arrangements, bandwidths and costs individual secondary schools are subject to under this program. The DoE should review the arrangements schools are making to ensure they are receiving value-for-money. Technology resources in schools also vary. At least half of all secondary schools are now operating a Bring Your Own Device program. Unless a particular type and model of device is specified, this can lead to a wide variety of devices depending on what families can afford, which is challenging for teachers to manage.

However, the type of device is less critical to learning with technology than the enthusiasm and knowledge of teachers and school leaders, the Committee was told. Schools without a specific ICT strategy or dedicated technologies teacher depended on particular teachers with skills and an interest in digital technology. Supportive and proactive principals could be instrumental in establishing a focus on digital technology. The DoE said it plans to address identified gaps in pre-service teachers' knowledge of digital technologies with the deans of university schools of education. It will also review professional learning in schools and ask schools to participate in skill development programs where necessary.

Considerations for the future

As schools increasingly use apps and software provided by big tech companies, the potential for student user data to be harvested using embedded artificial intelligence will become greater. Schools seem largely unaware of this potential, however the DoE is conducting a risk assessment of third-party providers to assist schools.

Many contributors to the inquiry were mindful that technology should not be used without consideration of its educational value. A link to foundational skills and the curriculum was important, and becoming creators rather than just consumers would help to ensure this. The Committee recommends that a method for integrating digital technology into the curriculum be part of the ICT Vision Statement, along with recommendations on ethical and legal aspects pertaining to its use. The DoE should also specify how it will provide more support to teachers in the form of software and online resources.

While there has been progress in digital technology use, innovations in digital learning need to be implemented in a systematic way, which can only happen with vision and leadership. A strategy that facilitates learning *through* as well as *about* digital technology is critical.

Ministerial Response

In accordance with Standing Order 277(1) of the Standing Orders of the Legislative Assembly, the Education and Health Standing Committee directs that the Minister representing the Minister for Education and Training report to the Assembly as to the action, if any, proposed to be taken by the Government with respect to the recommendations of the Committee.


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It has been three years since the Department of Education has had a current ICT strategy and vision statement for schools.

Recommendation 1 **Page 3**

The Department of Education must hasten its provision of guidance to secondary schools on the use of digital technologies. It should consider releasing the infrastructure component of the strategy separately, while continuing to work on the vision statement.

Chapter 2 – How digital technology is used to assist with engagement, inclusion and equity

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Secondary schools with students who are not attending or are disengaged from school report improved attendance and engagement when activities using digital technologies are introduced.

Finding 3 **Page 25**

Visual and audio aspects of digital technology may be particularly compatible with Aboriginal cultural traditions, such as storytelling. Digital tools can help disadvantaged Aboriginal students to learn and create in a way that is more suited to their culture.

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Use of digital technologies in regional schools is seen as a way of retaining students at the local school, ensuring the sustainability of small regional communities.

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The Committee is unaware of the degree to which students with a language background other than English are made aware of and provided with digital tools to assist them with English and language activities.

Finding 6 **Page 32**

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Finding 8 **Page 34**

The Department of Education provides assistive technologies and some professional learning support in the use of assistive technologies for school staff; however, studies suggest that the tools are under-used Australia-wide. We do not have evidence of this specifically for Western Australia.

Recommendation 2 **Page 34**

The effective use of assistive technologies in secondary schools should be part of the Department of Education's ICT Vision Statement.

Finding 9 **Page 36**

There are encouraging examples of how digital technology is being used to assist with engagement, inclusion and equity in secondary schools.

Recommendation 3 **Page 36**

The Department of Education needs to ensure that digital technologies designed to assist students with special needs are available and are being appropriately deployed to all students that require them, including those who:

- are from remote and regional areas
- are Aboriginal
- face socioeconomic, social and cultural challenges
- have a language background other than English
- have a physical or sensory disability
- have a learning difficulty
- are gifted
- have emotional, behavioural or mental health disorders
- are away from school for medical reasons

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There is wide variation in the arrangements, bandwidths and costs individual secondary schools are making under the School Managed Internet program.

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At least half of all secondary schools have a BYOD (bring your own device) program.

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Teaching students are not necessarily graduating with the skills they need to use and teach with digital technologies throughout curriculum areas.

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A goal of the Department of Education's ICT Vision Statement should be that teaching students graduate with skills to use and teach with digital technologies.

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Recommendation 7 **Page 51**

A goal of the Department of Education's ICT Vision Statement should be that in-service teachers are able to demonstrate the skills to use and teach with digital technologies.

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Schools seem generally unaware of the potential for data harvesting using artificial intelligence embedded into computing applications used in their classrooms.

Recommendation 8 **Page 56**

The Department of Education's ICT Vision Statement must include principles related to technical, social and ethico-legal aspects of digital technologies and the regular training required for teachers on these aspects.

Finding 21 **Page 59**

Education leaders are aware of the need to ensure that digital technology is being integrated into the curriculum to deliver desired learning outcomes, and not just for the sake of using it. Creating rather than just consuming is considered important.

Recommendation 9 **Page 59**

The Department of Education's ICT Vision Statement must clearly articulate a method for integrating digital technology into the curriculum.

Recommendation 10 **Page 60**

The Department of Education must outline in its ICT Vision Statement how it will provide more support to secondary teachers in the form of software for all subjects and online resources for teaching the ICT capability.

Recommendation 11 **Page 62**

The Department of Education's ICT Vision Statement must clearly define a shared goal for all students to learn with, as well as about, digital technology.

Chapter 1

Setting the scene

A goal without a plan is just a wish.

Antoine de Saint-Exupéry

Waiting for the vision statement

The Committee began its inquiry by following up an Auditor General's report that recommended that the Department of Education (DoE) undertake to establish a digital technology vision for the education of public school children in Western Australia.

In 2016 the WA Auditor General inquired into whether:

a) Information and Communications Technology (ICT) in public schools is appropriately planned and managed, and

b) public schools can access the ICT advice and support they need.

In relation to a), the Auditor General found that while the DoE had developed a document known as the ICT Vision Statement[1] and knew what ICT it would deliver to schools, it had not developed implementation plans or strategies for its vision or ways to measure its progress.[2]

One of the recommendations of the Auditor General's report was that the DoE update its ICT Vision Statement beyond 2016, to be completed by February 2017. In following up on the progress of the Auditor General's recommendations in April 2018, the Western Australian Parliament's Public Accounts Committee was told that the DoE anticipated that the ICT Vision Statement would be published by 30 October 2018.

At a hearing in June 2019 we asked the DoE about progress on the ICT Vision Statement. The newly appointed Director General Lisa Rodgers said that 'literally it is imminent' and a draft strategy would be published within the next few months, as they would be speaking to the Minister for Education and Training in 'the next week or so'.[3]

At this hearing the Director General remarked in response to a question that digital technology was a 'challenge' and 'opportunity' to be utilised by the Department of Education so that students could learn 'anywhere, anytime'. Given the expectation that the vision was imminent the Committee determined it appropriate to consider how digital innovation could assist secondary students to learn anything, anywhere, anytime.

1 Information and Communication Technology in the Western Australian Public School System: Vision Statement and Priorities 2014-2016.

2 Office of the Auditor General, *Information and Communication Technology (ICT) in Education*, Report 19, Perth, August 2016, p. 6.

3 Ms Lisa Rodgers, Director General, Department of Education, *Transcript of Evidence*, 12 June 2019, p. 16.

In a follow-up letter, the Committee then asked for a copy of the draft ICT Vision Statement, to be treated as closed evidence, or an outline of the key guiding principles of the statement. In response the DoE advised that the draft strategy remained a work in progress, saying 'It necessarily took a technological approach, which needs to be complemented with a strong focus on how it will enable students to reach their learning and achievement potential'.[4]

Executive Director of Statewide Services Lindsay Hale had commented in the June hearing on how the vision statement would address the way digital technology would be used by teachers to increase opportunities for learning. Mr Hale acknowledged that 'the tasks that people were given in creating the so-called vision was a vision that was actually about the technology'. He said there was a separate focus required, 'not just the nuts and bolts, but what it means in terms of learning and outcomes and how you use it'.[5] Despite this, it was made abundantly clear that the draft strategy was in the process of being approved, not 'a work in progress'.

However, in a subsequent hearing in September, the Director General, when asked about the content of the vision statement, said that what was missing from the strategy was 'how teachers and principals use technology to ensure that students get access to world-leading curriculum, and, of course, access to learning anytime, anyplace, anywhere'.

> We did have a draft ICT strategy, but I said I would like to build on this strategy and I would like to take the time to put the learner at the centre of the strategy, and so that is exactly what we are doing. That work is underway.[6]

While the Committee has been informed that the ICT vision is being expanded to encompass aspects as important as student engagement, teaching practices and learning outcomes, it is disappointing that the DoE was unable to share any of the guiding principles, particularly given it has been three years since the previous vision statement and priorities document expired.

This inquiry has found that the ongoing lack of a guiding document, for both ICT infrastructure in schools and the use of digital technologies to assist learning, is unhelpful to secondary schools. While DoE provides some technical support, schools have been left to determine the best use of digital technology on their own, often in silos.

While the 2014–2016 strategy was labelled a vision statement, it clearly did not serve this purpose. The DoE says that the initial draft of the updated strategy also did not provide a vision for the best use of digital technologies, but this was being rectified.

Since the commencement of the inquiry, and in the absence of the strategy, the Government has made the following infrastructure and policy announcements with respect to ICT:

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4 Department of Education, Letter, 16 August 2019, p. 1.
5 *Transcript of Evidence*, 12 June 2019, p. 14.
6 Ms Lisa Rodgers, Department of Education, *Transcript of Evidence*, 25 September 2019, p. 2.

- A tripling of bandwidth for more than 500 schools over the next year, with a minimum of 20Mbps
- A state-wide mobile phone ban for public schools, to be implemented in 2020.

Finding 1

It has been three years since the Department of Education has had a current ICT strategy and vision statement for schools.

Recommendation 1

The Department of Education must hasten its provision of guidance to secondary schools on the use of digital technologies. It should consider releasing the infrastructure component of the strategy separately, while continuing to work on the vision statement.

What digital technology opportunities are on offer

The idea of digital innovation to assist secondary school students to learn anything, anywhere, anytime is an appealing idea; certainly, we want our kids to be smarter than the smartphone in their hands. As connectivity increases throughout Western Australia, along with the capabilities of mobile devices, it seems logical that learning from a location of your choosing at a time and pace that suits you is feasible for more and more students.

Online learning is deliverable for students unable to physically attend school due to geographic isolation, illness, or physical, intellectual or social conditions. Western Australia's School of Isolated and Distance Education (SIDE) enables students to send and receive schoolwork electronically and connect with teachers and other students. Students attending a physical school campus generally complete parts of their education online also.

This inquiry set out to question the extent, benefits and challenges of online learning – in particular, whether it increases equity of opportunity in secondary education or magnifies an existing gap due to lack of access to the internet, hardware, resources and capable teachers.

While technology provides opportunities for students who are not on a school campus, we were particularly interested in the ways digital technology can be used to engage students at school and its potential for reducing absenteeism.

This inquiry was concerned more with ways of learning *with* technology than learning *about* technology. While both are necessary, we were primarily interested in how digital technology is used, or could be used, to assist teaching and learning across all secondary school subject areas, and not only what is being taught as part of the Digital Technologies curriculum.[7] This is consistent with the International Society of Technology in Education

7 Digital Technologies is one of two strands of the Technologies learning area, one of the eight learning areas taught from pre-primary to year 10 as part of the Western Australian Curriculum. The other strand is Design and Technologies. Schools are also expected to embed ICT Capability into the eight learning areas. ICT Capability is one of seven general capabilities identified as necessary to thrive in a rapidly changing world.

Standards for Teachers,[8] which in 2007 updated its focus to emphasise the importance of *using technology* rather than *learning to use technology*.

Digital technology is used in schools for a variety of purposes. Its role in enhancing teaching and learning was of more interest than its role in school administration and management, although we acknowledge the latter can impact on student learning.

The rest of this first chapter provides an overview of what sort of digital technology is currently available for secondary education and what is (and is not) being widely used in Western Australia's schools. It then reviews what is happening elsewhere in Australia and internationally in the educational technology space.

Chapter Two reports on how digital technology is being used to assist with engagement, inclusion and equity – including for students with disability, with learning difficulties or who are disadvantaged – and whether its potential is being fully realised.

Challenges to implementation, such as connectivity and bandwidth, school resources, teacher knowledge and capability, and school leadership, are examined in Chapter Three.

The final chapter, Chapter Four, discusses what should be considered for the future, including safety and ethical issues around the use of digital technologies in schools and ensuring educational outcomes are central to the use of technology. Details of the inquiry process can be found at Appendix Two.

It is difficult to know how much digital technology is being used

Digital technology is used in schools in Western Australia in a variety of ways, with some schools using it more extensively and deploying a much broader array of tools and products than others. Of course, there are many different applications for a single piece of technology, so while all students can access computers and/or iPads, the ways in which they do so can vary considerably depending on what software or apps are available to them.

The degree of independence now afforded schools means they are at liberty to decide what technology they will use and how it will be funded. While there are a handful of exemplar schools known to have adopted digital technology wholeheartedly, we did not conduct a survey of every public secondary school to ascertain exactly what is being used, to what degree and to what end.

The DoE's Executive Director of Statewide Services, Lindsay Hale, said that the take-up and teaching of digital technologies was 'very, very good', although there was 'a considerable way to go'.[9] The DoE did not provide evidence of the extent of its implementation across all schools.

8 The International Society of Technology in Education Standards for Teachers is one of two sets of K-12 educational technology standards used worldwide. The other set is the UNESCO ICT Competency Framework for Teachers. Both models have supported and informed educational reforms at a national level. Both seek to bridge the divide between old-school and connected learning.

9 *Transcript of Evidence*, 12 June 2019, p. 8.

The Committee was able to visit four public secondary schools during the inquiry as well as the DoE School of Isolated and Distance Education (SIDE), based in Leederville. Prior to the inquiry the Committee also visited Hale School, recognised nationally for its innovative technology strategies. These site visits provided the opportunity to observe the range of digital technologies being used and hear students' views of technology at their schools.

The Educational Computing Association of Western Australia provided valuable insights, both broad and specific, into how schools in WA are using digital technology. Further appreciation of what schools are using could have been provided by one of the DoE's key providers of technology to schools, Solutions IT, but the company did not respond to an invitation to make a submission and was unable to find time to attend a hearing.

The DoE provides baseline infrastructure and management systems to all public schools. All are provided with a connection to the internet and an allocation of bandwidth, so it is assumed that, barring connectivity issues, students will be engaging in online activities such as internet research and electronic communication.

All public schools operate a learning management system (LMS) which can connect teachers and students in an online environment and enable students to access learning content and assessments. The DoE provides an LMS called Connect, although SIDE chooses to use the WA-developed platform Moodle because of its flexibility, and some other secondary schools are using alternative platforms such as Google Classroom.

Students use Connect to contact their teachers, other students and experts outside of the school day for feedback and support with their work, according to the DoE. Parents are able to use the platform to securely access their child's online classes and additional system information such as attendance, assessment outlines and student reports. In term one of 2019, there were approximately 34,000 instances of online classes activated through Connect, involving around 130 secondary schools. Schools may vary in terms of which classes they operate in an online format. As an example, Morley Senior High School had initiated 443 Connect classes across all subject areas, with the year 11 and 12 ATAR subjects being the most active (see Box 1.1).[10]

Box 1.1: How Morley SHS uses Connect

443 Connect classes

14 online discussions

with **614** views and **95** comments

2047 items published

527 notices from staff/teachers,

viewed by **3781** students

539 assignments uploaded

1775 items downloaded by students

Source: Department of Education, Letter, 25 October 2019

Software such as Microsoft Office 365 Education is also available to students at no cost, providing not only tools to create documents, spreadsheets and presentations but tools for collaboration.

10 Submission 6, Department of Education, p. 1; Department of Education, Letter, 25 October 2019, p. 7.

The DoE, and particularly SIDE, also uses the video conferencing system WebEx to deliver live video lessons to students and enable student discussions and interaction.

While desktop computers are still used in many secondary schools (usually in computer labs), schools also provide laptops for students to use. In some schools these are shared devices, transported between classes as required. There are around 110,000 students enrolled in government secondary schools. According to the DoE's 2018 computer census, secondary schools had 27,854 laptops or notebooks for student use, 29,646 desktop computers and 12,673 tablets.

While the number of laptops has decreased since 2012 (from 42,042) along with desktop computers (from 31,221), the number of tablets schools provide has almost tripled, from 4262 in 2012 to 12,673 in 2018. In 2018, 35 per cent of the devices were older than four years, whereas in 2012 only 9 per cent were older than four years.[11]

A report by the Auditor General suggests that the reduction in the number of devices purchased by secondary schools since 2012 is due to more secondary schools introducing Bring Your Own Device (BYOD) schemes.[12]

3D printers, robotics kits, YouTube and educational games are commonly used

Educational technology, or edtech as it is commonly known, is a booming business. The first edtech market census for Australia, conducted in 2017, found that the sector is worth more than $1 billion per annum and reaches more than three million learners.[13] There is a plethora of software, apps, educational games, web-based tools and digitally-controlled devices being offered to schools. It can be challenging for teachers to keep up with the technology and know which tech tools to use.[14]

Students may also download apps or purchase software independently, making it even more difficult to know exactly what is being widely used. Home-schooled students (and their parents) have become particularly adept at finding useful online tools and courses, according to representatives from Home Education WA.[15]

Digitally-controlled devices being used in secondary schools include 3D printers and scanners, plasma and laser cutters, smartboards/interactive whiteboards (although these seem to be more widely used in primary schools), robotics kits, and, in some cases, virtual reality goggles (including Google Cardboard which can be used with a smartphone).

Much of the digital technology used in schools, however, requires only a computer, tablet or smartphone because it is software-based or web-based. Apart from the Microsoft Office

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11 Department of Education, *Computer Census Summary Report 3* and *2012-2018 Computer Census Data Extracts and Summary Tables*, 2018, accessed 4 October 2019, <www.education.wa.edu.au>

12 Office of the Auditor General, *Information and Communication Technology (ICT) in Education*, Report 19, Perth, August 2016, pp. 21-22.

13 Deloitte and EduGrowth, *Innovations to spark the future of education: The Australian EdTech Market Census 2017*, August 2017.

14 Ms Lynne Herbert, Deputy Principal (Primary), Merredin College, *Briefing*, 12 September 2019; Submission 9, Aboriginal and Torres Strait Islander Mathematics Alliance, p. 5.

15 Ms Saani Bennetts, Home Education WA, *Transcript of Evidence*, 25 September 2019, p. 4.

suite and school administration and management software provided by DoE, schools may commonly provide coding programs, the music notation software Sibelius for music students, Britannica and other research and learning apps.

Of course educational software is increasingly available in an online format, which solves the problem of software becoming outdated. It also makes it more portable i.e. between school and home.

In terms of web-based learning, students will access teacher-made video content from YouTube when appropriate, and there are a range of online courses and tools such as those offered by Khan Academy, 3P Learning (Mathletics and Spellodrome), Studyvibe – a WA-developed website containing educational resources designed to help secondary students develop effective research skills, and the Australian 24/7 tutoring service Studiosity. Some web-based tools, such as Spellodrome and the Literatu writing improvement program Scribo, use artificial intelligence to analyse students' performance and provide feedback to help teachers and students see what they need to focus on.

Some of the software and web-based products use gamification to make learning more enticing. Gamification is the process of introducing gaming elements and video game design into the learning environment. It plays on the natural tendencies of people to compete with each other, and to want to be recognised for their achievements by a community. Features of games such as points, achievement badges, leader boards and real-time feedback are used as incentives to participate and to strive to do well.[16]

Games such as Minecraft, which is part of the Microsoft software package, are widely used in schools, and some schools participate in e-sports, in which teams of students compete with each other in the realm of electronic games.

At Merredin College and Cecil Andrews College in Seville Grove – both public schools that have been designated DigiTech schools and Teacher Development Schools,[17] – a wide range of technology was in evidence. Merredin College had two 3D printers and a scanner, 3D pens (which extrude heated plastic to form 3D models), Lego Robots kits, green screens and tripods to create dance videos using iMovie on phones or iPads, virtual reality headsets for using with Google Expeditions, a 360° camera for creating virtual tours, drones, a set of publishing tools (Book Creator, Puppet Edu, Adobe Spark) and Google Classroom, the free web-based service for sharing files between students and teachers.

At Cecil Andrews College the students were engaged in robotics programs, a Vortals pilot program that allows students to incorporate virtual reality and augmented reality elements, e-sports, and a drone pilot program. They school also has the new all-in-one computer

16 Deloitte and EduGrowth, *Innovations to spark the future of education: The Australian EdTech Market Census 2017,* August 2017; E Southgate, S Smith and H Cheers, *Immersed in the Future: A Roadmap of Existing and Emerging Technologies for Career Exploration*, DICE Report Series Number 3, 2016.

17 DigiTech Schools assist other schools to implement the Digital Technologies curriculum by sharing teaching and learning practices and providing face-to-face and online support. They receive $44,000 over two years to assist with the mentoring role. Teacher Development Schools (TDS) are schools with expertise in digital technologies and STEM subjects that provide support to other teachers of STEM subjects through workshops, observation, mentoring and online learning communities.

scanner HP Sprout. The Sprout consists of a 23" touchscreen computer, a 20" touch sensitive mat, and a camera/scanner/ projector system. It enables students to scan an object, manipulate it digitally, and then create a 3D digital model.

Hale School also has an impressive array of digital technology, including an Oculus Rift virtual reality headset which students use in a virtual reality classroom. The VR program was developed by Hale School Learning Support staff in collaboration with Victorian-based IT company Lithodomos. A literacy app developed for the program uses VR and simulated experiences to explain literacy rules verbally and visually in an interactive way, which maximises student engagement with the content.[18]

The VR literacy program is a product of the Hale Institute of Innovation and Research, set up several years ago to encourage the school's teachers to generate innovative ideas and then support them in their development. Hale School also operates Hale@Home, an online distance learning program to assist primary school students from regional areas to transition better to the school ahead of their arrival in year 7. Students take part once a week for a year.[19]

There are a range of free and commercially available technologies which some schools may be using, but we did not receive evidence to confirm whether they are widely used.

For example, the site 360Cities offers a collection of free 360° videos and images for use with PCs, smartphones, tablets, or head-mounted devices (e.g. VR goggles), according to *Immersed in the Future: A Roadmap of Existing and Emerging Technologies for Career Exploration.* Devices for 360° video creation such as GoPro Omni and 360Hero are commercially available. 360° video can allow learners to control their view of environments from different perspectives and take them to places that would be too dangerous to visit in person, such as volcanoes. 360° video recorders and interactive video creation platforms (e.g. TED-Ed™ and EdPuzzle™) offer free tools for education-focused content creation, as well as paid alternatives. The report says that live streaming technology is commonly used, with many free applications available.[20]

Use of mixed reality (MR) and augmented reality (AR), according to the DoE, is not widespread since it was still cost prohibitive and curriculum content had not been developed.[21] AR allows computer-generated virtual objects to be overlayed into the user's physical world. Apps on smart devices overlay virtual content onto the real world but it is perceived as 2D (as in the Pokemon Go game). More immersive AR uses transparent head-mounted display (HMD) technology to project objects into the user's physical world, which are perceived as 3D. MR is a type of immersive AR (IAR) where digital content dynamically interacts with the real world.

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18 Mr Dean Dell'Oro, Principal, and Mr David Bean, Deputy Principal, Hale School, *Briefing*, 21 February 2018.

19 *ibid*.

20 E Southgate, S Smith and H Cheers, *Immersed in the Future: A Roadmap of Existing and Emerging Technologies for Career Exploration*, DICE Report Series Number 3, 2016, p. 28.

21 Mr David Dans, Department of Education, *Transcript of Evidence,* 12 June 2019, p. 6.

The *Immersed in the Future* report says that IAR is still in the development phase, and with headsets currently priced at between $850 and $4000 would not be affordable for at least another five years.

There was also limited application of haptics in education, according to the report. Haptics can create an in-depth sensory component to a simulated environment. It can be useful for teaching concepts such as the difference between weight and mass. For example, it can allow students to feel the weight of objects under the gravity of different planets in virtual reality, as objects are moved into different parts of the screen.

Of course, the pace at which technology is adopted can be very rapid. At the time of the publication of the *Immersed in the Future* report, just three years ago, the authors said that the HP Sprout had only been used for educational purposes in the US, but now it is being used by Cecil Andrews College and possibly other schools in Western Australia.

There are a range of digital technology tools which are used to assist students with special needs. These will be discussed in Chapter Two.

How do we compare?

In Australia the responsibilities for school education sit within multiple policy contexts at local, national and international levels. Legislative responsibility for school education rests with state governments, while the Australian government has the capacity to exercise power and control (or influence) through the financial grants it provides to the states and territories.

In 2008, the Australian government embarked on the Digital Education Revolution Initiative, providing more than $2.1 billion to be invested into the integration of information and communication technology into Australian schools.[22] A National Partnership Agreement provided the funding to the states and territories to provide computers and software to all students from years 9–12. The purpose was to 'contribute to raising the overall attainment of all Australian students so that they acquire the knowledge and the skills to participate effectively in society'. This drive was also articulated in a joint ministerial statement issued by the then Ministerial Council of Education Training and Youth Affairs and the Ministerial Council for Vocational and Technical Education:

> Australia will have technology enriched learning environments that enable students to achieve high quality learning outcomes and productively contribute to our society and economy. [23]

The Organisation for Economic Co-operation and Development (OECD) regularly collects data on the resourcing of schools and other institutions. As a member, Australia contributes data which can enable comparative analysis and allow policy-makers to gauge the knowledge and skills of Australian students in comparison with those in other countries. Data collected by the OECD for the 2015 Programme for International Student Assessment

22 dandolopartners, *DER Mid-Program Review Assessing Progress of the DER and Potential Future Directions,* n.d., p. 4.

23 S Thomson, 'Australian Students in a Digital World', *Policy Insights*, issue no. 3, June 2015, p. 3.

(PISA) report makes the following observations in respect to the number of computers available to students in the school for educational purposes, and how many of these are connected to the internet: [24]

> There are large differences in the computer-student ratio across education systems. In Australia, Austria, Canada, the Czech Republic, Iceland, Macao (China), New Zealand, the United Kingdom and the United States, there is at least one computer available per student, and at least 95% of the computers are connected to the Internet. By contrast, in Albania, Algeria, Indonesia, Kosovo and Tunisia, there is less than one computer per every five students, and less than 70% of the computers are connected to the Internet. [25]

Note, while the 1:1 ratio may have been correct at the time, the target ratio for Western Australia was subsequently modified to 1:5.[26]

Data collected for the same report included the testing of 540,000 15-year-old students across 72 countries in reading, mathematics and science, with results averaged and countries ranked from one (the highest) through to 70. While PISA could not identify cause-and-effect relationships between policies/practices and student outcomes, those countries identified as having the highest computer to student ratio were ranked from four through to 35, while those countries with the lowest ratio were mostly ranked in the high 60s. [27,28] This suggests that students perform better in the countries with better access to computers in the classroom.

The 2013 International Computer and Information Literacy Study (ICILS), which measured digital proficiency in a random sample of year 8 students in 21 countries, found that Australia was second only to the Czech Republic and was on par with Poland, the Republic of Korea and Norway. The definition used for the ICILS was 'an individual's ability to use computers to investigate, create and communicate in order to participate effectively at home, at school, in the workplace and in society'.[29]

However, the author of a paper analysing Australia's performance in the ICILS suggests that while Australian students are performing well on basic ICT literacy tasks, they perform less well when performing higher level ICT tasks. It was suggested that 'our education system could well be creating basically proficient ICT users but very few technicians, innovators or developers.'[30]

An OECD composite innovation index to measure overall change in pedagogical and organisational practices in schools between 2000 and 2011 shows Australia as among the

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24 Based on school principals' reports.
25 OECD, *PISA 2015 Results (Volume II): Policies and Practices for Successful Schools*, PISA, OECD Publishing, Paris, 2016, p. 191.
26 Office of the Auditor General, *Information and Communication Technology (ICT) in Education*, Report 19, Perth, August 2016, p. 23.
27 Albania 55, Algeria 68, Indonesia 62, Kosovo 69 and Tunisia 66.
28 OECD FactsMaps, *Average Score of PISA Mathematics, Science and Reading*, accessed 11 October 2019, < http://factsmaps.com>
29 S Thomson, 'Australian Students in a Digital World', *Policy Insights*, issue no. 3, June 2015, p. 8.
30 *ibid*., p. 16.

bottom third of countries for demonstrating innovation at the classroom and school levels. Australia was below the OECD average.[31]

How some other jurisdictions are delivering digital education

Digital technologies have provided an opportunity for a new kind of learning environment that is not restricted to the student and teacher together occupying a formal classroom setting. The following are a few examples of digital educational delivery in other jurisdictions.

Finland

Finland consistently ranks at the top of PISA and OECD league tables and has long been renowned for the quality of its education.[32] Curriculum changes implemented by the Finnish National Board of Education were gradually introduced into schools in 2016. This reform introduces the requirement for students to participate in at least one multidisciplinary learning module per year, studying what has been referred to as 'phenomena' or topics.[33] This recognised a need to 'move toward the future, when thinking skills, social interaction, information processing skills and skills in producing information are expected to play an important role'. [34]

The following two examples describe how digital technology is used in project- or phenomenon-based learning:[35]

> Their teacher is taking them through a video re-enactment – shown on the classroom's interactive smart board – of the day Mount Vesuvius erupted and destroyed the city of Pompeii. In groups they take out their mini laptops. Their task is to compare ancient Rome with modern Finland. One group looks at Roman baths and today's luxury spas; another puts the Colosseum up against modern-day stadiums. They use 3D printers to create a miniature of their Roman building, which will eventually be used as pieces for a class-wide board game. The children are also gaining skills in technology, research, communication and cultural understanding. Each group is becoming an expert on their subject, which they will present to the class. The board game is the culmination of the project, which will run alongside normal classroom teaching.
>
> One large project … was on the subject of immigration, when the flow of migrants into Europe was making headlines around the world. The topic was chosen because it became clear many of the students had little personal experience of immigrants and immigration. The topic was incorporated into German and religious classes. Their 15-year-olds carried out street surveys to garner local opinions about immigration, and they visited a nearby immigration centre to interview asylum

31 Organisation for Economic Cooperation and Development, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*, OECD Publishing, Paris, 2016, pp. 21-22.
32 Many of the practices in the Finnish education system are outside the scope of this report.
33 V Symeonidis and JF Schwarz, 'Phenomenon-Based Teaching and Learning through the Pedagogical Lenses of Phenomenology: The Recent Curriculum Reform in Finland', *Forum Oświatowe*, vol. 28, no. 2 (56), 2016, pp. 31–47.
34 *ibid*., p. 3.
35 P Spiller, 'Could subjects soon be a thing of the past in Finland?' *BBC News Finland*, 29 May 2017.

seekers. They shared their findings via video-link with a school in Germany, which had carried out a similar project.

China

The Distance Education Project for Rural Schools, implemented by the Chinese government between 2003 and 2007, was designed to improve the quality of basic education in rural areas of China. Part of this initiative saw 37,500 junior high schools provided with computer rooms with high speed internet and multimedia classrooms to allow students and teachers to download online and web-based materials. However, a shortage of teachers able to teach in specialised areas resulted in some curriculum courses either not being offered or being taught by teachers who did not have the necessary expertise.[36]

One of China's edtech companies, Hujiang EdTech, provides an interactive online learning platform, CCTalk, to overcome this. CCTalk integrates e-learning products with new technologies such as VR. It aims to recreate the traditional classroom experience online, using two-way live video and digital whiteboards to enable interaction between teachers and students. CCtalk hosts over 30,000 independent teachers (iTeachers) globally who provide thousands of classes.[37]

At a rural school with three students, the students log into the system to take part in live-streamed classes, asking questions as necessary. Students can take part in lessons in skilled subject areas such as music, where their own teacher has no expertise. Likewise, a music teacher who previously had to travel to various schools, teaching around 10 students at a time, now broadcasts to more than 100 students spread over 28 schools.[38]

Republic of Korea

The Cyber Home Learning System (CHLS) is a national open-access customised state-of-the-art learning system implemented in South Korea in 2004 that enables all K–12 learners with web access to study a range of topics.

The CHLS was created with three objectives in mind: (a) to close the educational access divide (b) to reduce private tutoring expenses, and (c) to improve the quality of public education. An important feature of CHLS is that it provides student users with individualised study management services. These services include customised learning using content for self-motivated study, a Q&A page with direct access to cyber teachers, formative and summative assessment of academic performance through online assessment tools, and a career counselling service for college applicants.[39]

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36 Shiling McQuaide, 'Making Education Equitable in Rural China through Distance Learning', *International Review of Research in Open and Distance Learning,* vol. 10, no. 1, 2009.

37 Hujiang EdTech, *Interactive Online Teaching Platform CCtalk -- A Major Contributor to Chinese Online Education Industry's Growth,* PR Newswire Association LLC, Cision*,* 23 August 2017, accessed 28 October 2019, <www.prnewswire.com>

38 Zen Soo, 'This remote Chinese school has just three students. But with live streaming technology, they share a classroom with hundreds'*, South China Morning Post* (web-based), 6 March 2018, accessed 26 July 2019, < https://www.scmp.com>

39 DJ Hwang, H Yang and H Kim, *E-Learning in the Republic of Korea*, UNESCO Institute for Information and Technologies in Education 2010.

Canada

Alberta Distance Learning Centre (ADLC)

The ALDC has a long, successful history as a leading distance education provider in Canada. The centre offers dozens of courses as well as the option to take them via three different delivery models – online, print, or blended learning.

Students are able to learn at their own pace and at times and locations convenient to them. They communicate online with their teachers and complete course work using a wide variety of print and/or digital content.

Newfoundland and Labrador Distance Education

The Centre for Distance Learning and Innovation (CDLI) is responsible for developing and delivering senior high school distance education and online teacher professional development, as well as leading K–12 technology integration initiatives in the province. CDLI offers 38 courses to students attending 103 schools, which are located in rural, remote, and isolated communities.

CDLI offers educators and students access to web-based learning resource content and multimedia learning objects that support provincial curricular learning outcomes. CDLI also provides 'live' online tutoring to students throughout the school year.[40]

Other parts of Australia

A recent report commissioned by the Australian Government Department of Education and Training gives a number of examples of artificial intelligence (AI) and the emerging technologies (virtual, augmented and mixed reality) in school education.[41] The report contains case studies illustrating the use of technologies in a range of learning areas, for example:

- VR used in a high school geography class where students were to create and present a plan for how an Australian city or suburb could be further developed to maximise economic, environmental and social sustainability. The task involved students presenting their plans through a VR tour.
- Science and Technology students using highly immersive VR to explore the human body. A formative VR assessment task was created which required the students to build models or cross-sections in VR that represented a bodily organ and demonstrated the depth of their research. They then took other students on a guided tour of their organ, explaining its parts and function based on their research.
- VR for theatre design. The students were creating a Director's Folio for a contemporary Australian play. While traditionally they would create a director's vision and explore this

40 S Howell and B O'Donnell, Digital Trends and Initiatives in Education: The Changing Landscape for Canadian Content, Association of Canadian Publishers 2017.

41 E Southgate, K Blackmore, S Pieschl, S Grimes, J McGuire and K Smithers, *Artificial intelligence and emerging technologies (virtual, augmented and mixed reality) in schools: A research report,* University of Newcastle, Australia, 2019.

in their set and costume designs, in this case they used VR and an associated program to explore and create an audience experience of their director's vision. The project was inspired by the National Theatre in the UK which created an immersive experience for its audience based on its director's vision. This approach takes the audience to a completely new place and extends the idea of theatre as an immersive art form.

- In 2018, the rural-based Mossman State High School committed to a focus on increasing the digital capabilities of the community. This involved the development of an action research project with the Australian Curriculum, Assessment and Reporting Authority (ACARA) which is currently being implemented. The projects included:
  - Mossman High Digital Showcase: Year 9 digital technologies students hosted over 100 students from local feeder primary schools to introduce them to the basics of Scratch coding, Edison Robots, drones and animations.
  - Mossman High Network Analysis project: Year 9 digital technologies students performed a school-wide network survey to document every piece of network equipment within the school. Students constructed detailed network diagrams and used this information to perform an analysis of the strengths and limitations of the school network.
  - Mossman High School Induction project: Year 9 digital technologies students are creating a school induction app for new and existing students to the school. The app will feature interactive school maps plus informative videos from staff and support services to help new students with the transition to Mossman High.

The case studies mentioned above illustrate how digital technology can be harnessed to provide new learning opportunities where none existed, as well as enrich the learning experience. The Committee saw examples of similar initiatives in Western Australia. For example, the resurrection of a previously mothballed technical room at a regional high school now used to deliver real-time interactive lessons in electronics to the school by SIDE; the use of robotics; gaming development; and VR goggles using Google Virtual Expeditions. The extent to which available technologies are used is linked to resourcing of hardware and software, as well as teacher buy-in and school leadership. These matters will be further discussed in Chapter Three.

Chapter 2

How digital technology is used to assist with engagement, inclusion and equity

Having ICT in the classroom allows that teacher to differentiate and make sure that the content resources delivered to that individual child actually meets them where they are at, rather than the delivery of one particular lesson to a whole group of students that could be in very different places in regard to their learning.

Ms Lisa Rodgers, Director General, Department of Education

Technology can tailor learning to students' interests to keep them engaged

It is widely accepted that engagement in learning is a predictor of success in later life.[42] An Australian study measuring the link between youth engagement status and subsequent labour market and social outcomes found that keeping disadvantaged young people engaged reduced their likelihood of experiencing disengagement as young adults by more than half.[43]

With secondary schools needing to cater for a range of students with diverse experiences and learning needs right up until the year they turn 17 or 18, teachers are legitimately concerned with ways to keep students engaged so that they finish year 12 with at least basic educational skill levels.

Students may be disengaged for any number of reasons – some because of learning difficulties (including being at a level significantly above the rest of the class), others because of social and cultural challenges, and some because of disabilities which mean they are not included in all classroom activities. Disengaged students are not necessarily the most disadvantaged or the most disruptive students, however. According to one study, at any one time, 20 per cent of students are 'compliantly disengaged', which means they are quiet but inattentive and uninterested. They are just as likely as disruptive students to be negatively affected academically.[44]

42 J Anderson and C Boyle, 'Inclusive education in Australia: rhetoric, reality and the road ahead', *Support for Learning*, vol. 30, no. 1, 2015, p. 6; Kirsten J Hancock and Stephen R Zubrick, *Children and young people at risk of disengagement from school,* prepared for Commissioner for Children and Young People WA, June 2015, p. 5.

43 J Thomas and C Nicholas*, Estimating the economic returns to flexible learning options in Australia – A social return on investment analysis*, James Cook University, Townsville, 2018.

44 M Angus, T McDonald, C Ormond, R Rybarcyk, A Taylor and A Winterton, *Trajectories of Classroom Behaviour and Academic Progress: A study of student engagement with learning*, Edith Cowan University, Perth, 2009.

According to a 2015 report, about 10 per cent of Australian students are considered to have a low level of engagement with school, with another 7 per cent considered to have very low engagement and another 3 per cent persistent, serious disengagement.[45] These students are not learning what they should be learning.

A 2015 OECD report stated that 17 per cent of Australian youth did not possess basic educational skill levels. The economic benefit of every school student achieving basic skills is calculated as worth 130 per cent of current GDP – a return which would, it was suggested, pay for the entire school system.[46]

Flexible or individualised learning programs tailored to student interests are a key feature of programs identified as assisting disengaged students at risk of leaving early.[47] It is perhaps not surprising to learn that research shows students are more engaged in their learning when they are interested and when the learning has some importance to them.[48]

McKnight (2017) writes that how much we learn is influenced by our motivation to learn, and that this is stimulated by 'tasks that are novel, not too difficult and not too easy, relevant to personal interests, and that give us choice and control'. These were the key principles of student-centred instruction, which was correlated with higher student participation and improved learning and achievement.[49]

According to Newhouse (2002), the learning environment afforded by ICT enables students to 'engage in authentic activities suited to their needs, work collaboratively and encounter problem solving situations which challenge them to think analytically'.[50]

As technology in education researcher Associate Professor Erica Southgate told the Committee, students and teachers want authentic learning, and technology helps to deliver this.

> They want to know how it connects to the real world. They want to be able to do things that are creative and interesting. They want to harness their interests with the technology in the classroom.[51]

Similarly, in speaking directly to students as part of a school and learning consultation in 2017, the Commissioner for Children and Young People found that:

> students were more emotionally and cognitively engaged in learning when the learning experiences were hands-on, interactive, enabled choice and autonomy,

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45 Kirsten J Hancock and Stephen R Zubrick, *Children and young people at risk of disengagement from school,* prepared for Commissioner for Children and Young People WA, June 2015, p. 7.

46 OECD, *Universal basic skills: what countries stand to gain*. Organisation for Economic Cooperation and Development, Paris, 2015.

47 Kirsten J Hancock and Stephen R Zubrick, *Children and young people at risk of disengagement from school,* prepared for Commissioner for Children and Young People WA, June 2015, p. 8.

48 Submission 2, Catholic Education Western Australia, p. 6.

49 K McKnight, *Leveling the Playing Field with Microsoft Learning Tools*, RTI International, 2017, p. 9.

50 Lorraine Kershaw, *Journeys towards expertise in technology-supported teaching*, PhD Thesis, Edith Cowan University, Perth, 2016, p. 13.

51 Associate Professor Erica Southgate, University of Newcastle, *Transcript of Evidence*, 14 August 2019, p. 6.

> and were supported by clear explanations … Students tended to not enjoy the 'didactic' methods of learning – for example, lecture, textbook work, and copying notes.[52]

The view of the Educational Computing Association of Western Australia (ECAWA) is that digital technology helps all students, whether or not they are gifted or at risk, because they are generally more engaged.[53]

As the Director General of the DoE, Lisa Rodgers, acknowledged, 'as soon as a student picks up a piece of tech – an iPad or whatever – we see immediate impact in terms of engagement'.[54]

If we can get them to school and if we can get them engaged in learning through the use of technology, then it is a win-win for us.

– Lisa Rodgers, Director General, Department of Education

Catholic Education Western Australia (CEWA) lists the following as some of the ways digital learning aids engagement:

- Allowing students to access new information and understandings of interest and importance to them
- Providing tailored individual learning programs that meet specific levels and needs
- Providing learning opportunities which allow students to work autonomously in some contexts, including out of school
- Providing opportunities for students to interact with other students and schools
- Providing opportunities for students to work at their own pace in certain contexts
- Reducing the emphasis on didactic learning and teaching.[55]

Beyond this, the Committee heard (and in some cases witnessed) how students at schools with robotics programs, virtual reality kits, gaming computers, a range of apps and online learning tools and 3D printing facilities were excited to be at school.

At Merredin College, attendance is above the State average. Students in the digital technologies and robotics lab on the day of the Committee's visit said that they were more encouraged to come to school when they knew they could be working on Lego robotics and other tech projects. In the year 10 dance class, where there are more males than females, the teacher tasked the students with making music videos using iPad apps such as iMovie as a way to keep them engaged. The students were keen to show their work, which was based on a rap song and included some images produced using a green screen.

Students in a Humanities and Social Sciences (HASS) class were exploring an international city many times the size of Perth via their VR headsets. VR was seen as fitting well with the

52 Submission 3, Commissioner for Children and Young People, p. 3.
53 Ms Shaloni Naik, Secondary School Coordinator, Educational Computing Association of WA, *Transcript of Evidence*, 25 September 2019, p. 6.
54 *Transcript of Evidence*, 25 October 2019, p. 5.
55 Submission 2, p. 6.

college's goals within the Innovation Partnership Schools program. This DoE program brings together clusters of schools and industry and community partners to explore professional practices that increase student engagement and achievement in digital technologies and science, technology, engineering and maths (STEM). Merredin College hoped to enable its students to make meaningful connections with the wider world through Google Virtual Expeditions, but it had also helped bring together everyone in the class, producing 'a real sense of energy and engagement and connection'.[56] The 'buzz' one of the teachers described as being present when students collaborate using tech tools was much in evidence at Merredin.

At another Wheatbelt school, Corrigin District High School, the vibe was completely different, although it is worth noting more than half of the secondary students were absent because they were attending a camp. Students at this school attend until year 10, at which point some may head to an agricultural college or TAFE, others to another regional school, and some to private schools in Perth. As the principal noted, the students who remain there beyond primary school are more likely to be disengaged. His assessment was that half of the 26 secondary students were disengaged, not necessarily in a disruptive way but certainly evident in their limited attendance and lack of participation in lessons.[57]

Fifteen laptop computers, which are a shared resource, and a set of iPads were the extent of the digital technology being used. There is no computer room, no electronics or robotics (apart from a small amount in primary school), no VR headsets. As some witnesses had pointed out, in regard to technology 'you don't know what you don't know'. The eight students we met seemed generally unaware of the possibilities available at other schools, and struggled to respond to questions about what digital technology they would like in their school and what they thought would be useful to learn about. With prompting, they settled on newer iPads, a laptop for every student and more bandwidth. While the Merredin students we met seemed motivated and happy to chat about their projects, most of these students seemed to be lacking inspiration. However, as noted above, some students were absent and the remaining students may not have been representative of all secondary students at the school. The principal said students who were disengaged or had learning difficulties would benefit from technology considerably.[58]

Cecil Andrews College is one of three secondary DigiTech schools in WA established to support the implementation of the Digital Technologies curriculum and develop innovative methods and practices. The college has a high number of students considered academically and socially vulnerable. Technology provides alternative ways of teaching concepts to students with poor writing, reading and numeracy skills. This includes allowing students to use iPads to record science experiments that they can replay to the teacher. STEM teacher Amanda Lean related how some students disengage the moment they see something that involves words or writing: 'They say "Miss, I'm not doing it".' Rather than writing up an experiment in the traditional form of a hypothesis and method and results, they learn the

56 Merredin College, *Innovation Partnership Program,* accessed 3 September 2019, <merredincollege.wa.edu.au>

57 Mr Bruce Fraser, Corrigin District High School, *Briefing*, 13 September 2019.

58 *ibid.*

correct terminology and concepts through a hands-on approach and a visual presentation of what they discovered using iPads.[59]

Cecil Andrews College Principal Stella Jinman said that a class of some of the most susceptible and disengaged students were regularly using the school's STEM centre and digital technologies and had become very motivated once they felt a sense of accomplishment. The attendance of some of the State's most vulnerable students, including students who worked with an engineer as part of the Armadale Youth Intervention Partnership, increased from 16 per cent to more than 86 per cent once they had a sense of 'we can do it', according to Ms Jinman.[60]

Senior school students who were running the school's e-sports program gained a sense of responsibility and accomplishment from mentoring younger students. Their ability to pursue e-sports at school (sometimes during and sometimes after school hours) is thanks to special computers and a separate network being set up specifically for this purpose. As part of the Curtin University consortium group for e-sports, the college targets students who are looking for a pathway to university to study gaming-related courses. Students are motivated to pursue further education in a field that they have had the chance to explore and enjoy at school.

A secondary school with similar demographics but no special status in terms of digital technologies struggles to find the resources to provide digital tech to its students – who nevertheless report that using the computer-based digital technology that they do have access to makes learning more fun (e.g. making a documentary instead of writing an essay). Students invited to the Committee meeting by the school leaders seemed very attuned to the opportunities afforded by digital learning and offered insights into how some of the limitations they encountered could be overcome. Some students were involved in an after-school robotics club set up by the P&C and supported by the school. Some of the staff representatives at the briefing were involved in the school's ICT working party to develop a whole school approach to teaching and learning ICT.[61]

The OECD reports that educational gaming can foster student engagement and motivation, with low-achieving students possibly gaining more from the experience than high-achieving students.[62] Another report states that at-risk and lower-achieving students benefit most from technology that is designed to promote high levels of interactivity and engagement with data and information in multiple forms.[63] Gaming fits this description.

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59 *Briefing*, 16 September 2019.

60 *ibid*.

61 Thornlie Senior High Schools, *Briefing*, 16 September 2019.

62 OECD Centre for Educational Research and Innovation, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*, OECD Publishing, Paris, 2016, p. 92.

63 Linda Darling-Hammond, Molly B Zielezinski and Shelley Goldman, *Using Technology to Support At-Risk Students' Learning*, Stanford Center for Opportunity Policy in Education/Alliance for Excellent Education, Stanford, CA, 2014, p. 15.

Box 2.2: How Minecraft gave a student a voice

University of Newcastle Associate Professor Erica Southgate described how a Minecraft VR project she introduced to students – some with special needs – at a low-income school combined fun and engagement and made heroes of some of the quietest students. Students who were not necessarily verbally confident or competent were able to shine in an activity that did not rely on speaking but was instead focussed on creating. The competence that they could demonstrate built their confidence.

> *'there was one student in that group who did an amazing job – incredible scientific understanding of the engineering properties of Minecraft but also of the biology they were studying. I was just standing there and he was talking about what he had learnt and the teacher said, "I haven't heard you talk in three years. I haven't heard you say a word in science in three years and look at you now." He was absolutely thrilled to be achieving in science through this kind of medium. This is a student who everyone thought would leave school early'*

Source: Associate Professor Erica Southgate, Transcript of Evidence, 14 August 2019, p. 8.

ECAWA president Michael King found games to be very helpful in the boys' school where he teaches, but noted that the competitive nature of gaming did not suit all students. ECAWA's secondary school coordinator Shaloni Naik said that gaming had been used in her school for about six years.[64]

The purpose of gamification, whereby game mechanics are superimposed on a non-game context, is to drive user engagement by providing an incentive to participate and achieve particular goals. Features of leisure games such as points, achievement badges, leader boards and real-time feedback are employed. This plays on a natural tendency to be competitive and to want to be recognised for achievements.[65]

A growing number of vocational education and training (VET) practitioners are turning to the visual and interactive elements of ICT to assist with learner engagement, reporting high success rates using game-based learning such as competitive quizzes set up like popular game shows. Some had used virtual worlds where learners create avatars and take part in role-play. The study of ICT use by VET students found that there was 'substantial evidence that the creative and strategic use of ICT can help to engage disengaged young learners and improve their learning outcomes'.[66]

The Committee was told how at Meekatharra District High School, a design and technology workshop which had been lying idle for about a decade was once again being used because the students could be taught by a teacher in Perth via video conference. A two-way camera and screen has been set up in SIDE's Leederville-based workshop and a screen and webcam in the Meekatharra workshop. Kits with the necessary materials are sent to the Meekatharra students and a supervisor assists on site. SIDE's Head of Online Teaching and Learning, Ross Manson, told the Committee that a group of Aboriginal boys with major attendance and

64 Educational Computing Association of Western Australia, *Transcript of Evidence*, 25 September 2019, p.6.

65 Deloitte and EduGrowth, *Innovations to spark the future of education: The Australian EdTech Market Census 2017*, Melbourne, 2017; Submission 13, FutureNow Creative and Leisure Industries Training Council.

66 Lucas Walsh, Barbara Lemon, Rosalyn Black et al., *The role of technology in engaging disengaged youth: final report*, Australian Flexible Learning Network, Commonwealth of Australia, 2011, pp. 13, 31.

participation issues were now turning up to school to learn woodwork. 'When the class can't happen there is almost a riot because the kids love it.' [67]

The same opportunity would be rolled out to some other regional schools, and SIDE electronics courses are already being offered using the same delivery method to students at Pannawonica, Shark Bay, Jigalong and Tom Price.[68]

Finding 2

Secondary schools with students who are not attending or are disengaged from school report improved attendance and engagement when activities using digital technologies are introduced.

Digital technology can contribute to an inclusive and more equitable education for students with special educational needs

The Melbourne Declaration on Educational Goals for Young Australians, published in 2008, outlined two goals for education: one, Australian schooling promotes equity and excellence; and two, all young Australians become successful learners, confident and creative individuals, and active and informed citizens. Successful learners, it elaborates, should have the essential skills in literacy and numeracy and are creative and productive users of technology, especially ICT, as a foundation for success in all learning areas.[69]

The goals were aimed at all school students, implying that education should be inclusive, rather than segregated.[70] Anderson and Boyle (2015) note that the meaning of inclusive education has shifted over the years from being exclusively about students with a disability to encompassing the delivery of a high-quality education to all students.[71] The Melbourne Declaration also emphasised improving outcomes for disadvantaged young Australians, particularly Indigenous youth and those from low socioeconomic circumstances, according to McGinty (2018).[72]

Anderson and Boyle (2015) report that Australian schools are facing the challenge of working with increasing numbers of disadvantaged students and many who come to school with a diverse range of experiences and learning needs. A longitudinal study of Australian children from 2013 estimated that 12 per cent of students in Australian schools have additional educational needs.[73] Home School WA said that the number of home-schooled children with learning difficulties had increased significantly over the past five years. Committee member Saani Bennetts said there had been a 'massive upswing' in students on the autism spectrum

67 *Briefing*, 7 August 2019.
68 Mr Noel Chamberlain, Principal, School of Isolated and Distance Education, Email, 8 November 2019.
69 Australian Curriculum, Assessment and Reporting Authority (ACARA), *NAP Sample Assessment: ICT Literacy*, ACARA, Sydney, November 2018, p. 1.
70 J Anderson and C Boyle, 'Inclusive education in Australia: rhetoric, reality and the road ahead', *Support for Learning*, vol. 30, no. 1, 2015.
71 *ibid.*
72 Sue McGinty, 'Preface', in Sue McGinty, Kimberley Wilson, Joseph Thomas and Brian Lewthwaite (eds), *Gauging the Value of Education for Disenfranchised Youth*, Brill Sense, Leiden, 2018.
73 J Anderson and C Boyle, 'Inclusive education in Australia: rhetoric, reality and the road ahead', *Support for Learning*, vol. 30, no. 1, 2015.

or with disorders such as dyslexia and ADHD, who were 'not coping in a regular class setting'. More people than in the past were taking up home education because they felt they had been left with no other option, with schools unable to cater to their needs.[74]

It is not clear to what degree digital technology assists students with special educational needs.

In this section we will use the OECD's Centre for Educational Research and Innovation (CERI) categories for comparing special needs education across nations:

- Students with disabilities or impairments viewed in medical terms as organic disorders (e.g. sensory, motor or neurological defect)
- Students with specific difficulties in learning, including behavioural or emotional disorders, with the educational need considered to arise from problems in the interaction between the student and the educational context
- Students with disadvantages, arising primarily from socioeconomic, cultural and/or linguistic factors, with the educational need being to compensate for the disadvantages attributable to these factors.[75]

Countries collect data within their own set of defined special educational need categories which the OECD then allocates to one of the three categories described above. There is some variability in categorisation; for example, some countries include gifted and talented students in the learning difficulties category, while others do not. For the purposes of this report, we consider gifted and talented students to fit the 'difficulties' category. The DoE's School of Special Educational Needs sums up the scope of its delivery as 'providing support for students with disabilities and diverse learning needs'.[76] Other programs within the education system endeavour to address inequity, and where these involve innovative digital solutions they will be discussed in this chapter.

Advantages for the disadvantaged

There is a symbiotic relationship between digital inclusion and disadvantage: disadvantage is both a cause and an outcome of digital exclusion. As the OECD states:

> The 'digital divide' has become a skills gap between the haves and have-nots. Digital skills generate a significant return in terms of employment, income and other social outcomes for those who have them, but set up barriers to better life opportunities for those without.[77]

74 Ms Saani Bennetts, Home Education WA, *Transcript of Evidence*, 25 September 2019, p. 4.

75 OECD, *Students with Disabilities, Learning Difficulties and Disadvantages: Policies, Statistics and Indicators,* 2007, p. 20.

76 Department of Education, *Schools of Special Educational Needs*, accessed 10 October 2019, <http://det.wa.edu.au/ssen/detcms/portal/>

77 Organisation for Economic Cooperation and Development, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*, OECD Publishing, Paris, 2016, p. 9.

The Australian Digital Inclusion Index (ADII), which has collected data on three dimensions of digital inclusion – access, affordability, and digital ability – since 2014, confirms that digital inclusion is unevenly distributed across Australia.

While digital inclusion has steadily increased over the four years from 2014 to 2018,[78] there is mixed progress across the different dimensions, geographic areas, and sociodemographic groups.

> In general, wealthier, younger, more educated, labour market participants and urban Australians enjoy much greater digital inclusion. Across the country, digital inclusion is clearly influenced by differences in income, education levels, and the geography of socioeconomic disadvantage. Some Australian communities are falling further behind – the gap between people in low and high income households is growing, as is the gap between those who are not in the labour force and those who are.[79]

The OECD reports that the link between the use of digital devices and the internet and a person's level of education shows that education matters in the uptake of digital technologies. This had 'huge implications' for the role of education systems in ensuring individuals have the required skills to benefit from new technology.

In terms of levelling the playing field at school, the DoE attempts to ensure that all students have access to a digital device and the internet[80] – but in some cases this limits opportunities for education to school hours, since some children may have to share devices and internet allowances at home with other family members.[81]

Among the most disadvantaged students socioeconomically are Aboriginal students. The ADII shows that Indigenous Australians living in both urban and regional areas have a low level of digital inclusion, with a score of 54.4 (5.8 points below the national score). The largest gap is in affordability. Indigenous Australians spend a greater portion of their household income on internet connectivity than other Australians, and receive less data for each dollar of expenditure. This reflects the prevalence of mobile-only use (34.7% compared to the national average of 20.4%) and mobile data costs that are much higher than fixed broadband. However, the gap has narrowed slightly since 2014, with the biggest improvement in digital ability. [82]

According to CSIRO Education and Outreach, research indicates that the oral and visual focus of digital technologies complements Indigenous ways of learning and sharing, and minimises

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78 An ADII score of 100 represents a hypothetically perfect level of Access, Affordability and Digital Ability. Australia's overall national score has increased from 54.0 in 2014, to 60.2 in 2018 (a 6.2-point increase over four years). Since 2017, the national score has risen by 2.2 points. Australia's overall performance indicates a moderate level of digital inclusion.

79 J Thomas et al., *Measuring Australia's Digital Divide: The Australian Digital Inclusion Index 2018*, RMIT University, prepared for Telstra, Melbourne, 2018, p. 10.

80 Mr Lindsay Hale, Department of Education, *Transcript of Evidence*, 12 June 2019, p. 15.

81 Corrigin District High School, *Briefing*, 13 September 2019; Thornlie Senior High School, *Briefing*, 16 September 2019; Submission 4, Ms Zina Cordery, p. 5.

82 J Thomas et al., *Measuring Australia's Digital Divide: The Australian Digital Inclusion Index 2018*, RMIT University, prepared for Telstra, Melbourne, 2018, p. 15.

language and literacy barriers.[83] This is also the view of a young Torres Strait Islands academic and Macquarie University PhD candidate, Rhett Loban, who developed a VR educational game based on Torres Strait Islands culture. He said that VR fitted well with Indigenous culture which had traditionally relied on storytelling and visual elements to pass on knowledge, rather than written forms.

> It is good at placing them in that experience and in that context. You can read something on a piece of paper or maybe someone can talk about it, but until you are actually kind of there and you really experience it, you do not always get a sense for it … Even in my game … we have a bit about astronomy. Astronomy is a really visual thing. You look up at the stars and you might find out where the stars are in the sky and which direction it is facing in. If you read about it, it does not really do justice to it in the same way for me, but if you put it on VR and you see it in VR, then that is real context and that is putting it in a real place for me.[84]

There are a number of programs, mainly STEM based, which use digital technology to engage rural and remote Aboriginal students. The Indigenous STEM Education Project, delivered by CSIRO Education and Outreach and funded by BHP, recognises that digital technologies are integral to the lives of Aboriginal students, with high mobile phone use providing opportunities for student-generated digital content. Digital tools enabled Aboriginal students to have agency over their learning, and to produce and share their own content without the input of adults or the non-Indigenous community. One of the programs, Inquiry for Indigenous Science Students (I^2S^2) had resulted in two-thirds of the students achieving an A, B or C grade, compared to only half achieving these results without the program.[85]

Cecil Andrews College STEM coordinator John Townley won a 2019 Commonwealth Bank Teaching Award for his robotics program which integrates Noongar culture and language with hands-on engineering. The first project for 2WAYSTEAM involved building a remote-controlled racing car and a track that embodies the six seasons of Noongar culture. The first students to take part were consistently disruptive children who Mr Townley invited to participate initially outside of class time. Based on their enthusiasm, he created a formal 2WAYSTEAM class. The robotics program has been extended to 11 other schools, including the Tjuntjuntjara Remote Community School in the Great Victoria Desert.[86]

Another WA project, developed by Edith Cowan University staff and supported by Australian Independent Schools WA, focuses on Indigenous language rather than STEM. CulturePad is a custom-built database for iPads that enables students to use visual, artistic and storytelling activities to engage with and record cultural knowledge and artefacts within their local community, building ICT and literacy skills at the same time. It can be used without an internet connection. One of the developers, Dr Jeremy Pagram, said CulturePad is a way of

83 Submission 12, p. 9.
84 *Transcript of Evidence*, 4 September 2019, p. 2.
85 Submission 12, pp. 6-7.
86 Commonwealth Bank Australia, *Newsroom - 2019 CBA Teaching Awards*, 29 March 2019, accessed 17 October 2019, < https://www.commbank.com.au>

preserving Indigenous languages. The software provides a framework for the content, but the content belongs to the communities, which decide how to use it.[87]

A roadmap for building Indigenous digital excellence has been developed by the Indigenous Digital Excellence (IDX) program supported by the National Centre for Indigenous Excellence (NCIE) and Telstra Foundation. One of five areas of focus is education, with one of the priority measures identified as: 'use technology to engage young people in education and to breakdown geographical barriers in accessing education'. This could be done by:

- building learning resources, including coding boot camps, online platforms, virtual classrooms (supporting frameworks) and mainstream courses for Indigenous students
- building foundational numeracy and literacy skills by stealth through gamification, robotics, 3D printing and programs like Flint
- including Indigenous perspectives in the innovation and technology curriculum.[88]

The roadmap document states:

> There is a dearth of knowledge on what innovation is out there and how communities and individuals are innovating. Such examples must be identified, captured and shared so that communities can learn from each other and not have to reinvent the wheel.[89]

While most of the IDX initiatives so far are based in the east, the IDX Flint program mentioned above has been delivered in Broome and Roebourne. The program works with Indigenous communities to deliver engaging STEAM-based learning[90] experiences for Indigenous youth (coding, robotics, 3D printing, drone technology and enterprise skills). It provides $25,000 worth of support to each community through hands-on workshops which include skills development for local facilitators, equipment and educational resources.[91]

Finding 3

Visual and audio aspects of digital technology may be particularly compatible with Aboriginal cultural traditions, such as storytelling. Digital tools can help disadvantaged Aboriginal students to learn and create in a way that is more suited to their culture.

Many Indigenous students also fall into the category of geographical disadvantage. Technology has the potential to give regional and remote students a range of experiences that they would not otherwise be able to access. Some of that potential is already being realised, with SIDE and CEWA's Virtual Schools Network providing online learning and delivering lessons by video conference to students right across the State, enabling completion of the same West Australian curriculum as other students.

87 *Transcript of Evidence*, 12 June 2019, p. 3.
88 Indigenous Digital Excellence, *A Roadmap for Building Indigenous Digital Excellence: Looking to 2030*, National Centre of Indigenous Excellence and Telstra Foundation, Redfern, NSW, 2016, p. 8.
89 *ibid*.
90 STEAM stands for science, technology, engineering, arts and maths.
91 Submission 14, Telstra Corporation Limited, p. 8.

CEWA notes that online learning is a good option for Aboriginal students in remote areas such as the Kimberley, where numbers of secondary students are often very small and trained staff difficult to secure. Issues of irregular attendance (perhaps due to population transience) can be assisted or overcome with online learning, but CEWA says there are challenges. In addition to connectivity issues, they cited lack of support resources and facilities at home, and lack of trained staff and technical support.[92]

Many other contributors[93] also raised the issue of the limited options for students at small regional schools which do not have the volume of students to warrant a big teaching staff. Teachers of specialised subjects are even more difficult to secure. At Corrigin District High School, for example, one teacher taught both secondary science and English, and there was no digital technologies teacher. Students stated that they completed homework in the digital technologies lesson.

Students studying for the ATAR exams in remote and regional schools can find their subject choices limited. While students should have the option to study a subject not being offered by their school through SIDE, the Committee questioned whether schools were reluctant to promote this option, given the implications for teacher numbers. The quandary is whether placing students into SIDE courses may restrict the range of courses being offered on campus, due to a reduction in student numbers for other courses.

NEWROC (the North Eastern Wheatbelt Regional Organisation of Councils) maintains digital technology offers the potential to ensure the sustainability of regional communities. It says that the ability of district high schools to provide high quality education via digital technologies will help retain current students and their families as well as attract new families.[94]

Similarly, the Isolated Children's Parents Association of Australia (ICPA (Aust)) says that rural schools are the centre of their communities.

> Good schools have the ability to retain and even attract families out into the regions, but families will quickly move away if they have concerns regarding their children's education.[95]

ICPA (Aust) asserts that technology and communications can assist in bridging the gap in some ways for geographically isolated students, but data limits, cost and ability to use and access the technology were barriers.[96]

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92 Submission 2, p. 12.

93 Submission 3, Commissioner for Children and Young People; Submission 8, NEWROC; Submission 13, FutureNow Creative and Leisure Industries Training Council; Submission 11, Gifted WA; School of Isolated and Distance Education, *Briefing*, 7 August 2019; Merredin College, *Briefing*, 12 September 2019; Corrigin District High School, *Briefing*, 13 September 2019; Department of Education, *Transcript of Evidence*, 25 September 2019, p. 12.

94 Submission 8, p. 1.

95 Isolated Children's Parents Association of Australia, *Submission to the Review of the Melbourne Declaration on Educational Goals for Young Australians*, June 2019, p. 4.

96 *ibid*., p. 5.

In its submission to the inquiry, FutureNow Creative and Leisure Industries Training Council says that studying locally is likely to lead to better youth retention if graduates are then able to find work close to home. The regions would require a tech savvy workforce in the future, particularly in the resources, community health, agriculture and telecommunications sectors, and skilling students locally would support their employability in these sectors.[97]

According to the 2016 *Immersed in the Future* report, emerging technologies could be used to provide a taste of post-school education and work possibilities for the many young people unable to access school-based work experience for geographical and other reasons.[98]

CSIRO's Virtual Work Experience Pilot Program enabled students 57 students – three-quarters from regional or remote areas, but none from WA – to take part in work experience projects using an online platform while in their schools or homes. Experienced CSIRO and industry STEM professionals acted as work experience supervisors, contacting them via video conference or an online platform. Without the virtual program, 29 per cent of the students would not have done work experience at all and a further 29 per cent of students, mostly from regional and remote areas, would not have been able to do STEM-related work experience.[99]

Immersive virtual reality could allow students to experience authentic simulations of work environments that are too far away or unsafe to visit, according to *Immersed in the Future*. Exposure through virtual worlds to potential careers for students from diverse socio-cultural backgrounds who may not otherwise envision themselves in those environments would also tackle the problem of 'You can't be what you can't see'.[100] Existing and emerging technologies could allow students to interact with virtual agents that are like them and open doors to professionals with a similar background.

> young Indigenous people who are aspiring to become doctors could be mentored by Indigenous doctors in an immersive virtual environment that would allow career exploration to occur within a culturally safe setting. Similarly, immersive virtual and augmented reality experiences could be designed so that first-generation students, particularly those who are geographically isolated, could explore the campuses and learning spaces of vocational or higher education so that these are demystified and less alien.[101]

Macquarie University researcher Rhett Loban saw VR as a way of bringing rural and metropolitan communities closer together and increasing understanding by filming experiences in one community and sharing it with the other. As the principal of one regional school commented, the students in small country towns often have a very limited range of

97 Submission 13, p. 1.
98 E Southgate, S Smith and H Cheers, *Immersed in the Future: A Roadmap of Existing and Emerging Technologies for Career Exploration*, DICE Report Series Number 3, 2016, p. 10.
99 Submission 12, pp. 4, 8.
100 E Southgate, S Smith and H Cheers, *Immersed in the Future: A Roadmap of Existing and Emerging Technologies for Career Exploration*, DICE Report Series Number 3, 2016, p. 11.
101 *ibid*.

experiences and have not interacted with people with a range of cultural backgrounds and life experiences.[102]

Finding 4

Use of digital technologies in regional schools is seen as a way of retaining students at the local school, ensuring the sustainability of small regional communities.

Students from refugee or migrant backgrounds, and particularly those who have a language background other than English (LBOTE), are among the most disadvantaged students.[103] We did not receive any evidence in relation to how technology can be used to assist these students, or whether it is being used in WA secondary schools, apart from a comment from the Commissioner for Children and Young People that technological assistance may prove a valuable support for them.

We do know, however, that Microsoft provides a Translator app and Learning Tools[104] for reading which support English language learners. One of the tools, Immersive Reader, will read materials in languages other than English. It currently accommodates 30 languages and is still expanding, and the Dictation Tool supports nine languages.[105] In a recent US appraisal of the Microsoft Learning Tools, one teacher said that the Immersive Reader was a great way for English language learners to access reading content that was above their reading skills level, because they were able to comprehend the text when it was read aloud. It was a way to 'even the playing field'.[106] We do not know to what extent LBOTE students in WA are made aware of and provided with these tools.

Finding 5

The Committee is unaware of the degree to which students with a language background other than English are made aware of and provided with digital tools to assist them with English and language activities.

A 2015 Australian study considered the potential of ICT for improving participation and peer co-operation during collaborative language learning episodes for English as an additional language/dialect (EAL/D) students. Web-based ICT such as blogs, wikis, Google Docs, Skype, Facebook and online chat services were found to alleviate the foreign-language anxiety experienced by EAL/D students when more competent language users dominate collaborative activities. Computer-mediated communication was found to be more effective for English language learner participation and peer co-operation than traditional face-to-face

102 Mr Bruce Fraser, Corrigin District High School, *Briefing*, 13 September 2019.

103 Callum Downes, 'Using information and communication technologies to promote participation and peer cooperation during collaborative literacy tasks for English-language learners', *Journal of Student Engagement: Education matters*, vol. 15, no. 1, 2015, p. 2.

104 Learning Tools is a set of features included in Microsoft OneNote, Word, Outlook, Office Lens iOS, and Edge Browser, available for free as part of O365. It was designed using research-based strategies to support reading and writing skills for people of all ages.

105 K McKnight, *Leveling the Playing Field with Microsoft Learning Tools*, RTI International, 2017, p. 29.

106 *ibid*., p. 34.

interactions.[107] While it is possible that LBOTE students are using these types of services informally at home, we are not sure whether they are being used formally in schools in WA.

Students with learning difficulties do not need to stand out or miss out

The types of technologies that are useful for English language learners are also used by students with learning difficulties. In most countries included in the OECD report on *Students with Disabilities, Learning Difficulties and Disadvantages*, learning difficulties include language learning disorders such as dyslexia, emotional and behavioural disorders, mental health disorders, students who are gifted or talented and students who have to spend extended time in hospital. Any of these conditions impact the student's ability to function in the school environment.

The School of Special Educational Needs: Medical and Mental Health (SSEN: MMH), which supports around 5500 students from both public and non-government schools, says technology 'has transformed what we do on every level'.[108] Whenever young people are unable to attend school for medical and mental health reasons, the school endeavours to provide educational services, whether from within a hospital or Department of Health program or at home. Where travelling to support students at home with lessons was once prohibitive, students can now receive lessons via video call.

SSEN: MMH said that young people often have the best outcomes when they remain connected to their enrolled school and continue the school's curriculum, and technology had enabled this to happen. Through a partnership with Missing School, seven young people had been able to use their mobile devices to control telepresence robots in the classroom where they would otherwise have been taking their lessons. They were able to move the robot around and engage and connect with their peers and their teacher.

Our students with dyslexia use color overlays and single-line reading. In the past they weren't made too much fun of, but still stood out. Now they get their information how they need it, and there is no stigma. It's really cool.

– From *Microsoft Accessibility and Assistive Technologies for Education, Forrester Research Inc.*

Assistive technologies like text-to-speech software, speech recognition software and C-Pen Readers can support students with dyslexia and dyscalculia to become more independent learners.[109] The C-Pen Reader, which the Committee saw demonstrated at Hale School, is a pocket-sized device that scans and reads text aloud with a human-like digital voice. It has an in-built dictionary which instantly displays the definition of a word highlighted by the user of the pen. The pen can also capture lines of text for uploading to a computer, assisting teachers and students to produce written work based on their reading.[110]

107 Callum Downes, 'Using information and communication technologies to promote participation and peer cooperation during collaborative literacy tasks for English-language learners', *Journal of Student Engagement: Education matters*, vol. 15, no. 1, 2015, p. 8.
108 Mr Caleb Jones, Department of Education, *Transcript of Evidence*, 25 September 2019, p. 3.
109 Submission 4, Ms Zina Cordery, p. 4.
110 Hale School, *Briefing*, 21 February 2018.

The advantage of tools that are integrated into mainstream software (such as the Microsoft Learning Tools) is that they remove the stigma attached to using a special tool. Students with learning difficulties can easily and discreetly access the help they need.[111]

Gifted WA says that tools such as voice recognition software can help a child who is unable to type, and apps such as iWordQ help students with dyslexia and dysgraphia. Robots help students on the autism spectrum to engage in lessons, reducing frustration or limitations in areas the student finds difficult. Apps such as IstudiezPro, Online Stopwatch and programs like Live Binders assist students with executive function challenges to organise their day-to-day tasks and long-term planning.[112]

Students who may otherwise be unable to demonstrate their level of knowledge are given the opportunity to do so through digital technology tools. The mother of a home-schooled secondary student said that audio books had assisted her 17-year-old son to demonstrate his literature analysis skills.

> (H)e gets very tired reading a lot. He can analyse literature, for example, extremely well. But if you just say to a kid, 'Because you can't read and write, you're not going to access this literature', you do not know whether they actually have those analytical skills.[113]

Gifted WA points out that gifted students may also have any number of disabilities, including speech and language disorders, emotional/behavioural disorders, physical disabilities, autism spectrum or other impairments such as attention deficit hyperactivity disorder (ADHD). They are known as twice exceptional or '2e' students. Digital technologies could play an even greater role in ensuring the talents of these students were unmasked.[114]

> ***… digital innovation has huge potential in secondary education to provide gifted children with the resources, stimuli and opportunities and connections they need to think at a higher level.***
>
> *– Gifted WA*

A number of contributors mentioned being able to learn at your own pace as an advantage of digital technology. Adaptive courseware designed for adaptive learning – which takes into consideration the diversity of learners rather than adopting a 'one-size-fits-all approach' – offers teachers comprehensive student data from which individualised learning paths can be developed.[115] According to the DoE, this prevents students from becoming disengaged with content that is not suitable to their level of understanding. The DoE submission says that programs are used by teachers Australia-wide which provide instant feedback on student performance and progress, allowing students to learn independently or competitively.

111 Forrester Research Inc., *Microsoft Accessibility and Assistive Technologies for Education,* a Forrester Total Economic Impact™ study commissioned by Microsoft, February 2019.
112 Submission 11, , p. 6.
113 Mrs Christina Kardol, Home Education WA, *Transcript of Evidence*, 25 September, p. 4.
114 Submission 11, p. 6.
115 Submission 12, CSIRO Education and Outreach, p. 9.

Gifted WA says that computer adaptive technologies and pre-testing on topics/subjects would make learning more equitable for gifted students in the classroom, who would not need to sit through hours of lessons being taught what they already know.

Computerised adaptive testing (CAT) can be used for both pre-assessment testing and to increase engagement in particular topics through apps and other games, according to Gifted WA.

> CAT technology enables the difficulty level of questions to change according to the answers a student gives. Hence the questions are truly personalised for the individual student's ability, enabling a gifted student to better engage as the questions become more complex, and therefore to reach a higher level, more reflective of their ability.[116]

Gifted WA says that with more gifted students in WA than places in secondary gifted and talented selective programs, digital innovation can enable students to virtually access specialised teaching and courses. Research had shown that gifted adolescents preferred online courses with students identifying a desire: to learn more about a particular content area; to study at their own pace or to get ahead; to gain advanced placement credit; and to access extra coursework that they could not fit into their school schedule.[117]

> ***If I am teaching kids how to program a computer, I have a variety of levels there from a student who has never touched it before … to some kids who I feel are more capable than I am … It gives me the opportunity to set a challenge for that more gifted student who can work independently, or I can point them towards some resources, and they are happy to take on that more challenging task while I get to spend more of my face-to-face time with the students who are struggling a little.***
>
> *– Michael King, ECAWA*

Digital technology could also enable students to easily enter competitions, which was motivating for some gifted children, and to present their projects to a wider audience – another motivating factor.[118]

Aside from the intellectual benefits, digital technology offered social advantages for gifted children. Gifted WA says that gifted children choose friends who are closer in mental age, rather than chronological age. Given the small numbers of gifted students,[119] it can be difficult to form friendships with similar peers, leaving their social skills lagging. Connecting online with others around the world who shared their interests and abilities could help in this regard.

116 Submission 11, Gifted WA, p. 3.
117 *ibid*.
118 *ibid*.
119 The lowest levels of giftedness are said to occur at a rate of 1 in 100, with exceptionally gifted children 1 in 1000. – *Gifted WA.*

Gifted WA maintains pre-service teachers are taught very little about gifted education at universities, but online training and resources could assist.[120]

Finding 6

Evidence from Home Education WA suggests that more families are opting for home schooling because their children's special needs are not being catered for at school.

Finding 7

Evidence from Gifted WA is that use of digital technology can assist gifted students, who otherwise may become disengaged and not achieve according to their potential.

How students with disability use assistive technology

The Committee did not receive any submissions from students with disabilities, their families, or disability support groups other than Autism WA.

The OECD special educational needs category of disability encompasses physical disability, sensory disability (blindness, deafness, visual impairment, hearing impairment), mental disability and severe/moderate autism. The DoE says that many students with disability are able to achieve educational standards commensurate with their peers with adjustments to the way they are taught and the means through which they demonstrate their learning. ICT could be an important tool for these students.[121]

Assistive technology includes both low-tech devices, such as picture boards and walkers, and high-tech devices. These include electronic communication devices, using synthetic or digitalised speech for augmentative and alternative communication and micro switches to control computers.[122]

Two of the DoE's four Schools of Special Educational Needs cater for students with disabilities. The School of Special Educational Needs: Sensory (SSEN: S) provides educational support for children with a hearing loss and/or vision impairment. Assistive technologies for students with vision impairment include screen reading and screen magnification software, braille computers and video magnifiers. According to the DoE's submission, SSEN:S is also investigating software to support real-time captioning in classrooms to assist students with hearing loss.[123]

SSEN:S, in partnership with Catholic Education Western Australia (CEWA), is trialling an initiative to support both public and non-government school students with sensory loss in regional, rural and remote locations (in the Kimberley, Mid West and Wheatbelt) via CEWA's

120 Submission 11, p. 5.
121 Submission 6, p. 3.
122 P Karlsson *et al*, 'Stakeholders' views of the introduction of assistive technology in the classroom: How family-centred is Australian practice for students with cerebral palsy?', *Child: care, health and development*, vol. 43, no. 4, March 2017, p. 599.
123 Submission 6, p. 3.

Virtual School Network.[124] CEWA has trained DoE visiting teachers to provide virtual support for the students, who would otherwise only receive support in person on quarterly visits.[125]

CEWA says that technology is providing options to assist students with sensory disabilities more than ever before. Learners could control their visual, hearing, and vocal interactions with technology which improved their access to learning materials. CEWA says that inclusivity is at the centre of many of the digital tools it is adopting.[126]

Computers, smartphones and tablets come with accessibility settings and built-in assistive services, and some mainstream software also has accessibility options for people with disabilities. Microsoft's Learning Tools have been shown to assist students with reading and writing.[127] Microsoft provides a list of its accessibility features under the categories of vision, cognitive, hearing, and mobility so people with specific disabilities can see which features work best for them.

One of the more commonly used Learning Tools in schools, Immersive Reader, can read text aloud, change text size and spacing and highlight individual words or one, three or five lines at a time. A captioning service for students with hearing impairments can also be enabled within the Office 365 Video software.

The School of Special Educational Needs: Disability (SSEN: D) provides students with a specific learning disability with laptops with pre-installed software. It also facilitates professional learning for teachers in the use of tools for literacy and numeracy, such as WordQ 5, WordShark 5, Co-Writer, Clicker, Snaptype Pro and NumberShark; tools for communication – for example Pragmatic Organisation Dynamic Display books, gaze, speech devices with switching systems; C-Reader pens; and the accessibility features of iPads and Microsoft 365.

Because the Microsoft 365 tools are standard and often cloud-based, students can access their content and many tools from a school device, home computer/tablet, or mobile phone, enabling continuity of experience. A report commissioned by Microsoft to analyse the value of the tools says that this is particularly important for students with mobility disabilities including limited reach, strength, and movement, and students unable to attend a campus.[128]

Autism WA writes that students with learning difficulties can capture elements of their lessons using cameras and microphones for photo, video and audio recording. Learning materials could be provided electronically, reducing the demand for handwriting and allowing students to learn at their own pace, or revise material at a later time.

Communicating via technology could also help children with autism with social skills, according to Autism WA. Not communicating in real time removed the need to interpret

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124 Ms Lisa Rodgers, Department of Education, Letter, 12 July 2019, p. 4.
125 Submission 2, Catholic Education Western Australia, p. 10.
126 *ibid*., p. 11.
127 Forrester Research Inc., *Microsoft Accessibility and Assistive Technologies for Education,* a Forrester Total Economic Impact™ study commissioned by Microsoft, February 2019.
128 *ibid*., p. 10.

non-verbal language, tones of speech and contextual cues, which autistic children often struggled with. This could increase their confidence with social interactions and potentially lead to opportunities for social relationships extending beyond communication via technology.[129]

Schools can send a request for whole school assistance, individual student assistance or equipment assistance to SSEN:D, which will then allocate a consulting teacher.[130]

An Australian Education Union survey from late 2018 found that four out of five public school principals felt they lacked the resources to properly educate students with disabilities. According to government figures, almost one in five students receive support for a disability, but 82 per cent of principals said there was not enough assistance for teachers in the classroom and 63 per cent said there was not enough specialist support.[131]

Various studies report assistive technology being underutilised in schools.[132] According to the Australian Disability Clearinghouse on Education and Training (ADCET), students' knowledge of inclusive technology varies; by the time they reach the post-school stage, some may have no knowledge at all whilst others will already be experienced in using technologies to access their studies and demonstrate their knowledge.[133]

Interestingly, the Senate Education and Employment References Committee's 2016 report *Access to real learning: the impact of policy, funding and culture on students with disability* mentions almost nothing about technology despite having a chapter titled 'How to better support students with disabilities in schools'. The Committee is aware that the Royal Commission into People with Disabilities is focussing initially on education, and will take note of the outcomes.

Finding 8

The Department of Education provides assistive technologies and some professional learning support in the use of assistive technologies for school staff; however, studies suggest that the tools are under-used Australia-wide. We do not have evidence of this specifically for Western Australia.

Recommendation 2

The effective use of assistive technologies in secondary schools should be part of the Department of Education's ICT Vision Statement.

129 Submission 1, Autism Association of Western Australia, p. 3.
130 Department of Education, *One Classroom*, accessed 22 August 2019, <http://det.wa.edu.au>
131 Fergus Hunter, 'Public schools lack resources to meet needs of 'invisible' students with disabilities', *The Sydney Morning Herald* (web-based), 17 February 2019, accessed 10 October 2019, <www.smh.com.au>
132 P Karlsson *et al*, 'Stakeholders' views of the introduction of assistive technology in the classroom: How family-centred is Australian practice for students with cerebral palsy?', *Child: care, health and development*, vol. 43, no. 4, March 2017, p. 599.
133 Australian Disability Clearinghouse on Education and Training, *Inclusive Technology*, accessed 30 August 2019, <www.adcet.edu.au>

There is a need to move beyond the potential for delivering equity, to actuality

This chapter has established the potential of digital tools and assistive technologies to level the playing field in education. Establishing what is actually being used has remained elusive. Much of the evidence received has talked about the ways in which digital technology could be employed to benefit disadvantaged students and those with learning difficulties and/or disabilities, rather than what is actually happening.

A report on inclusive education from 2013 found similarly that there was a lack of literature reviewing actual practices and 'a dearth of data on good inclusive practice in most jurisdictions in Australia'.[134]

While the DoE provided evidence that assistive technology and software is provided to public school students, we cannot be sure how well it is being implemented and applied. There were encouraging examples of the way digital technology has engaged vulnerable students, but it is also clear that the experience across schools is very uneven. This aspect will be discussed further in Chapter Three.

The fact that there has been an increase in home-schooled students with additional needs might suggest that many schools are not catering well for these students. But technology was only part of the solution, according to Home School WA representative Saani Bennetts. While having technology in the classroom would certainly make a difference to some of these students, Home School WA members had indicated that there needed to be support across a range of areas.[135]

Some of the technologies are, of course, useful for all students and not just those with special needs. Technologies that are designed to meet the needs of all learners conform to Universal Design for Learning (UDL) principles. This is a way of thinking about teaching and learning that helps give all students an equal opportunity to succeed. The principles include providing multiple modes of engagement, representation, action and expression.

Digital technology helps educators meet these principles, according to CEWA. CEWA says that as more digital standards are created in software, educators would learn more about the tools and techniques they could implement and students would feel more at ease in an inclusive classroom.[136]

The Committee is confident that digital technology can improve engagement and retention and help to level the playing field for students with special needs or who are from disadvantaged backgrounds. There is not enough evidence to the Committee to illustrate that this potential has been realised.

134 CI Forlin, DJ Chambers, T Loreman, J Deppler and U Sharma, *Inclusive Education for students with disability*: *A review of the best evidence in relation to theory and practice,* Australian Research Alliance for Children and Youth, 2013, p. 30.

135 *Transcript of Evidence*, 25 September 2019, pp. 4-5.

136 Submission 2, p.11.

Finding 9

There are encouraging examples of how digital technology is being used to assist with engagement, inclusion and equity in secondary schools.

Recommendation 3

The Department of Education needs to ensure that digital technologies designed to assist students with special needs are available and are being appropriately deployed to all students that require them, including those who:

- are from remote and regional areas
- are Aboriginal
- face socioeconomic, social and cultural challenges
- have a language background other than English
- have a physical or sensory disability
- have a learning difficulty
- are gifted
- have emotional, behavioural or mental health disorders
- are away from school for medical reasons

Chapter 3

Digital strategy

As the internet has become the default medium for everyday exchanges, information-sharing, and access to essential services, the disadvantages of being offline grow greater. Being connected is now a necessity, rather than a luxury.

From *Measuring Australia's Digital Divide: The Australian Digital Inclusion Index 2018*

Technology use and the importance of internet access

Connectivity and bandwidth were raised more often than any other challenges in regard to implementing digital technology in secondary schools.[137] The announcement by the WA Government to increase bandwidth to public schools is clearly recognition that reliable internet connection is a foundation to accessing the available technology.

The Department of Education (DoE) provides a certain amount of bandwidth based on student numbers and ensuring connectivity is a complex and important task. The Committee recognises that with more than 800 schools spread over an area of 2.5 million square kilometres, providing a reliable internet connection to the State's public schools is not simple. As EduGrowth Managing Director David Linke pointed out, the Western Australian school network is one of the most complex networks imaginable, consisting of very large urban schools, significant regional schools and tiny remote schools. [138]

The DoE now has 97.1 per cent of primary and secondary schools on a fibre connection. This was not expected to increase, since those not on fibre are very remote schools where 'the ability to run a fibre service to them is either impractical, impossible or just physically not achievable at this stage'.[139]

Schools, particularly in certain locations, have raised concerns about slow and unreliable internet access.

– Department of Education submission

These remote schools use the Sky Muster satellite service, provided by NBN through retail service provider Clear Networks. Fifteen use satellite only, and five are also on copper or 4G connections. A supplementary satellite service (Sky Muster Plus) has been installed at all of these schools.

The 5G mobile network is still three years away, according to DoE Chief Information Officer David Dans, and even further away for remote and regional communities. While it would not

137 Comments about poor connectivity and insufficient bandwidth were made in submissions from CEWA, Zina Cordery, Edith Cowan University, Department of Education, CSIRO, in hearings by Erica Southgate and ECAWA representatives, and by staff and students at the schools the Committee visited.

138 *Transcript of Evidence*, 4 September 2019, p. 3.

139 Mr David Dans, Department of Education, *Transcript of Evidence*, 12 June 2019, p. 3.

be practical or suitable for many of DoE's schools, Mr Dans said it was something they would 'add to the arsenal of things that we can provide schools'.[140] Of the 812 schools:

> some are connected by satellite, some have services that are washed away regularly by weather events and those sorts of things, particularly in the north west. The challenge for us is how do we make sure schools are able to continue to use services in those events? There are also large volume users, so 100 people connecting to the same service, and sometimes a limited service in those places.[141]

FutureNow Creative and Leisure Industries Training Council argued the delivery of online and immersive technologies had the potential to 'significantly transform the opportunities available to the State's regional and remote communities'.[142] It acknowledged significant improvements have been made in the provision of connectivity to regional hubs in the past five years, but maintained that more connectivity was needed to support the reliable delivery of remote education solutions beyond these major hubs.

Six Wheatbelt local governments which form NEWROC (the North Eastern Wheatbelt Regional Organisation of Councils) have addressed the challenge of reliable internet connectivity by establishing a network of 11 solar-powered telecommunications towers. The service uses NBN fibre from Merredin and wireless technology to provide a high-speed internet service (delivered by WA telco Crisp Wireless) to 150 or more customers. NEWROC said the high-speed service is a significant enabler for digital technology and innovation in the schools across the region.[143]

At the hearing with the Committee in June, the DoE said it was about to undertake a tender process in regard to internet provision. At present, core provision is through Telstra, with satellite services provided by NBN.[144]

The DoE must procure ICT services through one of the three prime contractors (NEC, Datacom and ATOS) appointed by the WA Government under its GovNext-ICT procurement model. The prime contractors compete to provide a cost-effective strategy for the DoE,[145] using suppliers such as Telstra.

While Telstra declined an invitation to a hearing, citing confidentiality issues around the tender process,[146] NBN Co told a Committee hearing that it was working with the three prime contractors to scope fit-for-purpose solutions for the DoE.[147]

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140 *Transcript of Evidence*, 12 June 2019, p. 5.
141 *ibid.,* p. 2.
142 Submission 13, p. 2.
143 Submission 8, p. 2.
144 Ms Lisa Rodgers, Department of Education, *Transcript of Evidence*, 12 June 2019, p. 3.
145 Department of Finance, Department of the Premier and Cabinet (Office of Digital Government), *GovNext-ICT Common Use Arrangement (CUA) GNICT2015*, Government of Western Australia, 7 June 2019, p. 2.
146 Telstra subsequently provided a submission.
147 Mr Simon Lawton, Industry Consultant, Business Segment, NBN Co, *Transcript of Evidence*, 18 September 2019, p. 5.

NBN Co said there was an opportunity for the DoE to upgrade schools in the NBN fixed-line footprint to either fibre to the premises or Enterprise Ethernet, which supports speeds of 1Gbps. The DoE investing in NBN as the wholesaler would give schools the opportunity to choose from different retail service providers and to regularly change their provider, NBN Co told the Committee.[148]

In a 2018 report reviewing the GovNext-ICT implementation, Auditor General Caroline Spencer said that many agencies delivered their services through legacy ICT models that failed to take advantage of significant improvements in both cost and function. Ms Spencer said that:

> modernising agency ICT must be about providing agencies with approaches that are flexible, secure and cost effective. All agencies need to consider the approach that best fits their purpose and service delivery[149]

Mr Dans said that one of the challenges of the GovNext-ICT model was that it was difficult to fit to a school scenario. A centralised model was impractical for remote schools in particular.[150]

The Committee encourages the DoE to consider any cost and delivery implications from being locked into an inflexible long-term contract in a period of rapid change in ICT delivery.

Finding 10

Almost all schools are now connected to the internet by fibre, but maintaining connectivity across the State is a challenge which the Department of Education is constantly forced to address.

Bandwidth is being upgraded

While the DoE currently provides schools with a centrally-supplied bandwidth of at least 10Mbps (megabits per second), most schools receive in excess of this. Allocation is based on the size of the school and the availability and cost of the Telstra service, with no upper limit set. The department is commencing work with Telstra to increase bandwidth allocation to schools over the next year, which will result in more than 500 schools receiving three times their current bandwidth and some others receiving twice what they currently receive. For schools where the infrastructure makes it impossible to triple or double the bandwidth, the DoE will, where possible, increase the minimum to 20Mbps.[151] Centrally-supplied bandwidth will now be calculated using a kilobit-per-user model (bringing WA into line with most other Australian jurisdictions) which takes into account staff use as well. The aim is to deliver

148 Ms Jane McNamara, Head of NBN Local WA, NBN Co, *Transcript of Evidence*, 18 September 2019, pp. 2, 5.
149 Office of the Auditor General, *Implementation of the GovNext-ICT Program*, Perth, August 2018, p. 4.
150 Mr David Dans, Department of Education, *Transcript of Evidence*, 12 June 2019, pp. 1-2.
151 Hon Sue Ellery Minister for Education and Training, *Bandwidth upgrades to boost student learning*, media release, 11 October 2019.

100Kbps per user [152]across all schools (where possible) by term 3 of 2020.[153] The department says it currently provides an average of 25Kbps.[154]

The DoE says that availability and type of bandwidth is not uniformly distributed, being more difficult to source in outer metropolitan, regional and remote areas. In some locations the department had exhausted available supply, but was working with providers on alternative solutions. While DoE was constantly seeking to continue to improve school connectivity and centrally provided capacity,[155] this could be a challenge, particularly in older schools. Thornlie District High School, which is 40 years old, is an example of a school where poor infrastructure creates a bottleneck at the point of delivery, irrespective of the quality of the pipe delivering the internet right up until that point.[156]

Prior to the announcement of the bandwidth increase, the Edith Cowan University (ECU) School of Education submission argued that there is 'a sense of disconnect' around what constitutes a core service for a school, and called for

> a wholesale review of the way access to the Internet is made available to Government schools and what would be a minimum requirement reflective of the third decade of the 21st century.[157]

The Educational Computing Association of WA said that when it canvassed its members in preparation for a hearing with the Committee, there was 'an explosion' of comments on the topic of bandwidth and connectivity. ECAWA member Shaloni Naik, who also teaches at Ashdale Secondary College, said that the school had had limited internet for many years, and this had caused a chain reaction.

> Not only do students and staff get frustrated with slow speeds of internet, but also it affects our BYOD program. Schools cut funding to buy devices because we are shifting to BYOD, but students do not want to bring their devices if they cannot access the information … We are currently at 400 megabits per second, but we are still unable to do things like give students YouTube access. How are we supposed to provide 24/7 access to learning or video tutorials if we cannot have YouTube open?[158]

A review as proposed by ECU could consider other jurisdictions. South Australia's school students are being provided with almost a megabit each, with schools to be provided with up to and beyond one gigabit by 2020.[159] In Victoria, schools are being upgraded to between 20Mbps and 500Mbps (depending on student numbers) and to 1Gbps for schools that have

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152 Kbps = kilobits per second; Mbps = megabits per second; Gbps = gigabits per second. Relationship between units: 1000Kbps = 1Mbps; 1000Mbps = 1Gbps.
153 Submission 6, Department of Education, p. 6; Submission 14, Telstra Corporation Limited, p. 5.
154 Department of Education, Letter, 25 October 2019, p. 4.
155 Submission 6, p. 5.
156 Ms Donna McDonald, Thornlie Senior High School, *Briefing*, 16 September 2019.
157 Submission 7, School of Education, Edith Cowan University, p. 3.
158 *Transcript of Evidence*, 25 September 2019, p. 8.
159 Telstra, *Bringing high-speed internet to South Australian schools*, 19 March 2019, accessed 23 October 2019, <www.telstra.com.au>

a 'highly digital approach to teaching and learning'.[160] New South Wales aims to deliver network speeds greater than 1Mbps per student by 2020, increasing to 5Mbps by 2025.[161]

Table 3.1: Comparison of bandwidth delivery to schools across three states

State	Bandwidth per user	
Western Australia		By 2020
South Australia		By 2020
New South Wales		By 2020 By 2025

100 kilobits per second (Kbps)

Finding 11

South Australia, Victoria and New South Wales have higher bandwidth targets than Western Australia.

Recommendation 4

The Department of Education should review the bandwidth per user target in light of other States' targets.

Schools that want to use an amount of bandwidth beyond what the DoE provides can purchase more from their own budget, under the School Managed Internet (SMI) program. They can use any provider in the area that is on the approved government procurement list, but the choice can be limited depending on location. The purchased service must still be routed through DoE infrastructure to ensure security protocols are met. As at the end of September 2019, around 260 schools had taken up SMI, according to the DoE.

A list of 46 secondary schools with SMI was provided to the Committee. The amount of bandwidth purchased per month ranges from 22Mbps (Jurien Bay District High School) to 1000Mbps (Canning Vale College, Duncraig SHS, Willetton SHS). Three schools are purchasing 500Mbps per month (John Curtin College, Rossmoyne SHS, Shenton College) and four are purchasing 400Mbps per month (Ashdale Senior College, Carine SHS, Comet Bay College, Perth Modern School). The most common bandwidth amount is around 100Mbps, which 24 schools are purchasing; another 10 schools are purchasing 50Mbps per month. *(See table 3.2.)*

Despite the DoE stating that testing had shown that 1Gbps (1000Mbps) was not warranted at any sites in WA at present,[162] three schools have purchased this amount. At the DoE

160 Victoria State Government, Education and Training, *Lifting digital experience and connectivity of schools,* 5 September 2019, accessed 22 October 2019, <https://www.education.vic.gov.au>

161 AARNet, *Submission to National Regional, Rural and Remote Tertiary Education Strategy,* 1 February 2019, p. 4.

162 Department of Education, Letter, 25 October 2019, p.1.

Table 3.2: Costings for secondary schools/sites using the School Managed Internet program

School/site	Provider	Cost per month ($)	Bandwidth (Mbps)
Canning Vale College	Vocus Comms	3999.00	1000
Duncraig Senior High School	NEC	3250.00	1000
Rossmoyne SHS	Vocus Comms	2399.00	500
Willetton SHS	TPG	1948.00	1000
Yanchep SC	Vocus Comms	1385.00	100
Coodanup College	Telstra	1293.00	100
Bunbury SHS	Ciphertel	1150.00	100
Aveley SC	Cloud Corp	1111.00	100
Comet Bay College	Telstra	1066.00	400
Balga SHS	Datacom	1064.00	100
Wanneroo SC	Datacom	961.00	100
Armadale SHS	Vocus Comms	899.00	100
School of Isolated & Distance Education	TPG	825.00	700
Ashdale SC	Datacom	799.00	400
Balcatta SHS	Vocus Comms	799.00	100
Southern River College	Vocus Comms	799.00	100
Perth Modern SHS	Telstra	719.00	400
Carine SHS	Telstra	700.00	400
John Curtin College	Vocus Comms	658.90	500
Shenton College	Vocus Comms	548.90	500
Kalamunda SHS	Wideband	548.90	50
Mukinbudin DHS	Crisp Wireless	500.00	50
Sevenoaks SC	Node 1 (WiFi)	199.95	100
Cape Naturaliste College	Telstra	139.00	100
Australind SHS	Aussie BB	120.00	100
Kinross College SC	iiNet	109.99	100
Ocean Reef SHS	iiNet	109.99	100
Melville SHS	iiNet	109.99	95
Bridgetown HS	Aussie BB	109.00	100
Girrawheen SHS	Aussie BB	109.00	100
Warwick SHS	Aussie BB	109.00	100
Yule Brook SC	Aussie BB	109.00	100
Wongan Hills DHS	Aussie BB	109.00	98
Dalyellup College	Aussie BB	109.00	50
Geraldton SHS	Vocus Comms	104.50	100
Busselton SHS	Telstra	100.00	50
Atwell College	iiNet	99.00	100
Waroona DHS	iiNet	99.00	100
Dalwallinu DHS	Telstra	90.00	50
Gingin DHS	Aussie BB	89.00	50
Malibu School ESC	Aussie BB	89.00	50
Jurien Bay DHS	Aussie BB	89.00	22
Newton Moore SHS	Aussie BB	84.00	50
Narrogin SHS	iiNet	79.99	50
Lesmurdie SHS	iiNet	79.95	100
Collie SHS	Exetel	70.00	50

Note: Shaded rows are regional schools
Source: Department of Education, Letter, 25 October 2019.

target rate of 100Kbps per user, a large school such as Shenton College (2400 users) will require 240Mbps. Shenton College currently receives 100Mbps from the DoE and purchases another 500Mbps. Rossmoyne SHS is also purchasing five times the amount of its DoE allocation of 100Mbps. Balga SHS and Girrawheen SHS are much smaller schools (547 and 421 students respectively) so only receive 20Mbps from the DoE, but they too are

purchasing five times this amount – an extra 100Mbps. Perth Modern School is purchasing eight times its allocation of 50Mbps.

Approximately 29 per cent of the 160 secondary schools pay for more bandwidth. Two of the schools the Committee visited said it was unaffordable for them to purchase additional bandwidth.

Merredin College, which is a specialist technology school, operates within its 20Mbps DoE allocation by doing a lot of activities offline. Despite the NBN being available nearby, the school has not signed up for it because it is regarded as too expensive.[163] Cecil Andrews College, which is also a specialist technology school, had not been able to fund additional internet from its budget; however, the recent increase to its bandwidth allocation has rendered purchasing additional internet unnecessary.[164]

The 46 schools with SMI are paying between $70 and $3999 per month for their additional bandwidth.[165] As one would expect, the lowest cost is for 50Mbps while the highest is for 1000Mbps. However, some schools are paying higher prices for smaller amounts of bandwidth. For example, Rossmoyne SHS is paying more per month for its 500Mbps ($2399) than neighbouring Willetton SHS is paying for 1000Mbps ($1948). They are using different service providers. Similarly, three metropolitan schools[166] are paying $700-$800 for 400Mbps while two[167] are paying $799 for only 100Mbps.

There are other significant cost differences between schools receiving the same amount of bandwidth, some of which can be explained by location (regional versus metropolitan). Some of the more extreme cost differences may be explained by whether the service is residential or commercial. The average cost of a commercial service is almost 12 times the cost of a residential service, according to the DoE ($1293 per month compared to $109 per month). A commercial service guarantees speed, symmetrical bandwidth (100Mbps inbound and outbound) and provides fibre optic technology.[168] Five of the schools buying 100Mbps are paying more than $1000 a month, so we assume (and hope) that these are commercial services. Still, there are inequities; Balga SHS is paying $1064 for 100Mbps for a commercial service, while Ashdale Senior College is paying less than this ($799) for a commercial service with more bandwidth (400Mbps). They are with the same provider, but we understand the cost for Balga is higher because there was limited uptake of NBN in the area at the time the contract was signed, attracting a higher tier charge. The best price listed for 100Mbps was $79.95, at Lesmurdie SHS. Eleven schools were within $10 of the average $109 per month charged for a 100Mbps residential service.

The difference in what money will buy is well illustrated by comparing Shenton College and Kalamunda SHS. They are using different providers, but both providers focus on business services, not residential. Both schools are paying $548.90 per month, but Shenton College is

163 *Briefing*, 12 September 2019.
164 Ms Stella Jinman, Cecil Andrews College, *Briefing*, 16 September 2019, and Email, 21 November 2019.
165 Note, these figures provided by the Department of Education are as advised by the 46 schools with SMI at a fixed point in time.
166 Ashdale Senior College, Carine SHS and Perth Modern School
167 Balcatta SHS and Southern River College
168 Department of Education, Letter, 25 October 2019, Attachment.

receiving 10 times the bandwidth of Kalamunda (500Mbps compared to 50Mbps). Without knowing the details of the contracts, such as what services are included, and whether infrastructure differences at the sites might account for the variation in bandwidth, it is not prudent to comment further. However, these examples serve to highlight the huge variability in what schools are paying for SMI and raises the question of whether value for money is being achieved in all cases. This is particularly critical for schools with smaller budgets, which are often smaller schools in areas where a good internet connection may be harder to attain.

The DoE says that the Student-Centred Funding Model (SCFM) includes school characteristic funding to ensure that schools are not disadvantaged due to their size or location. A locality allocation is provided to eligible schools in outer regional and remote areas 'to help meet the complexities unique to their locations and the higher costs associated with operating in regional and remote locations'.[169] It is not clear whether this includes the cost of additional internet provision.

The SCFM also provides extra funds for schools with Aboriginal students, students facing social disadvantage, students with English as an additional language and students with a disability. While some of the top performing and highest ICSEA[170] schools are on the SMI list, some of the lowest ICSEA schools, such as Balga SHS and Girrawheen SHS, are also paying for extra internet. Perhaps it is the social disadvantage funding from the DoE which enables this. However, as stated earlier, some schools say they cannot afford to pay for additional internet. Without further analysis, we do not know whether this is because of infrastructure costs in their location, other priorities within the school which require funding or the inability to source a good deal from an internet service provider.

The 2016 Auditor General's report *Information Communication Technology (ICT) in Education* noted that more than half of the schools visited during the audit were relying on staff with limited ICT experience to make significant investment decisions in the procurement of ICT. At 7 of the 12 schools, the principal, business manager or teachers were responsible for ICT planning despite having little or no ICT expertise. This meant there was 'a significant risk of making ICT investment and management decisions without understanding the lasting impact on the school'.[171]

The Auditor General also noted that smaller schools and regional schools were at a relative disadvantage due to the fact that the DoE's model of student-centred funding:

> does not fully recognise that schools have varying levels of access to ICT expertise. Schools that lack internal expertise or are unable to fund ICT support are more likely to make poor ICT planning and investment decisions and be less able to ensure their ICT is operating reliably and used well.[172]

169 Department of Education, Letter, 25 October 2019, p. 3.
170 Index of Community Socio-Educational Advantage.
171 Office of the Auditor General, *Information and Communication Technology (ICT) in Education*, Report 19, Perth, August 2016, p. 16.
172 *ibid*., p. 7.

The DoE says schools make their own arrangements for SMI and the department does not have access to the contractual arrangements.

Finding 12

There is uncertainty as to whether the Student-Centred Funding Model takes adequate account of differences in school connectivity and ICT support.

Finding 13

Almost one-third of secondary schools have chosen to supplement their bandwidth allocation by entering into a retail arrangement for extra bandwidth.

Finding 14

There is wide variation in the arrangements, bandwidths and costs individual secondary schools are making under the School Managed Internet program.

Recommendation 5

The Department of Education should review the contractual arrangements schools are making with internet retail service providers to ensure they are receiving value-for-money.

Digital resources in schools

Computers and associated hardware and software are a significant budget item for schools.

Merredin College's designation of digital technology as a priority in the school's three-year business plan has ensured clear direction for all staff and provided the digital technologies teacher with the confidence to apply for a significant portion of the annual budget to be spent on items such as programmable Lego robotics kits. It has also ensured that the grant from a local windfarm was targeted towards the purchase of 3D printers and a scanner.

Similarly, Cecil Andrews College's business focus has led to investment in digital technology. As a P-Tech school[173] (as well as a DigiTech and Teacher Development School), the school leverages business and industry partnerships where possible to fund its technology programs and hardware.

While Thornlie SHS has an after-school robotics program supported by parents, competing demands and limited facilities appeared to limit the potential for digital technology activities at the school. Indeed, while there was enthusiastic support to ensure the robotics club was funded (jointly by the P&C), and the school leadership and teaching staff were committed, the physical limitations on the campus hampered delivery.[174]

As Catholic Education Western Australia identified:

173 P-Tech stands for Pathways in Technology. The Australian Government program offers secondary students an industry-supported education pathway to a STEM-related qualification. See footnote 17 for a description of DigiTech and TDS.

174 *Briefing*, 16 September 2019.

> The conundrum of equity in education is that the schools who are often most in need of ICT and other technologies are usually the schools which are least well resourced to acquire and maintain them.[175]

CEWA cross-subsidises schools with fewer resources but says the capacity of parents to purchase the necessary hardware and also maintain sufficient technology in the home environment remains an ongoing challenge.[176] School leaders need to acknowledge the potential challenges in respect to affordability and accessibility for students and families.

Finding 15

There is a wide variation in digital technologies resources between schools.

Decisions regarding the acquisition of devices (laptops, notebooks, tablets and mobile telephones) are left to the individual school, with some schools opting for shared resources or encouraging a Bring Your Own Device (BYOD) or Personally Owned Device (POD) program. The DoE provides guidance on personally owned and bring your own devices on its website.[177]

A report by the Auditor General suggests that the decrease in the number of devices purchased by secondary schools since 2012 may be due to more secondary schools introducing BYOD schemes.[178] The DoE lists 81 secondary schools as having a BYOD agreement in place[179] (see Appendix 7), but it is likely that there are another 15 or more that have a BYOD program (without an agreement).[180] Data from the DoE's publicly available 2018 computer census indicates that in that year, 97 secondary schools had a BYOD or POD program in place (translating to an estimated 35,310 student users) with a further 20 schools considering implementing a program.[181] Based on these figures, half of all secondary schools have a BYOD agreement in place and more than half (around 60 per cent) have a BYOD program.

The DoE said it was unable to provide us with the number of schools with a BYOD program for each year from when the program was introduced; however, the 2018 computer census contains BYOD data for 2016 and 2017, which shows 87 secondary schools with a BYOD program in 2016 and 96 in 2017. The program appears to be growing, but not rapidly.

175 Submission 2, p. 16.
176 *ibid.*
177 Department of Education, *Personally Owned Devices and & Bring Your Own Devices*, accessed 14 October 2019, < http://det.wa.edu.au>
178 Office of the Auditor General, *Information and Communication Technology (ICT) in Education*, Report 19, Perth, August 2016, pp. 21-22.
179 Department of Education, Letter, 25 October 2019, Attachment.
180 Department of Education, *2012-2018 Computer Census Data Extracts and Summary Tables*, 2018, accessed 15 October 2019, <www.education.wa.edu.au>
181 *ibid.*

The wide variation in the age and functionality of devices students bring to school can make lesson delivery challenging for teachers, and students with older and/or less capable devices can be significantly disadvantaged.[182]

The provision of devices varies between states. Most states allow schools to operate a BYOD program. In Victoria, schools can meet the 1:1 device model by providing a school-purchased device, operating a BYOD scheme or by a co-contribution arrangement whereby parents partner with the school to contribute to the purchase or lease of a device.[183] Only the Australian Capital Territory provides students with laptops. As of this year, all secondary students have been provided with a Chromebook laptop, which they can take home. This was to ensure all students have the same access to a device, irrespective of family circumstances.[184]

The DoE was also unable to provide details of how much money students/parents were spending on devices they were being asked to provide, since the costs are not tracked centrally and would vary depending on the volume, type and model purchased.[185] In some schools, the type of device the students must provide is specified. However, other schools, particularly where affordability may be an issue, allow students to bring any device, resulting in a wide variety of devices.

Finding 16

At least half of all secondary schools have a BYOD (bring your own device) program.

It is up to schools to manage their BYOD or POD program. Since the Committee's visits to selected schools, the WA Government announced its new mobile phone policy, to be effective from 2020. One of the schools had already instituted a policy that mobile phones brought on site had to be signed into the office. Those that allowed the use of mobile phones for learning had 'Acceptable Use of Technology' agreements/policies in place.

While one school banned its students from using mobile phones during breaks, it had freed up its mobile phone policy to allow use in class with teacher supervision, because this was the device of choice for most students. In this case the principal maintained that teaching students the etiquette of appropriate use was within their remit.

ECU education lecturer Dr Jeremy Pagram argues that the latest technology is not a given for successful learning, as it is the use of the technology that matters:

> If you go to a very expensive private school, there is so much technology you almost fall over it getting in the door. They are very technology rich. As long as those underlying principles are followed of what is the educational value of the

182 Mr Chee Liew, Thornlie Senior High School, *Briefing*, 16 September 2019; Nicola Johnson, 'Schools are asking students to bring digital devices to class, but are they actually being used?', *The Conversation* (web-based), 26 March 2019, accessed 31 October 2019, <theconversation.com>

183 Victoria State Government, Education and Training, *Personal Devices – Parent Payment and Access*, 22 May 2018, accessed 8 November 2019, <www.education.vic.gov.au>

184 ACT Government, Education, *Better Schools for Our Kids: Technology Enabled Learning*, accessed 11 October 2019, <https://www.education.act.gov.au>

185 Department of Education, Letter, 25 October 2019, p. 4.

> technology, then it does not matter that somebody has got the latest whizbang and somebody has got something that is not quite as good, because the key educational advantage might be very much the same. So we need to look at the technology that is being used in schools and say, 'Okay, what is the outcome? Yes, it is cool. There's students walking around with goggles. What is the educational underlying thing, the transferable skill, they take away?' As long as we make sure those are equivalent across the system, there is a good chance that it will not be a big discrimination.[186]

The OECD also says that the successful integration of technology in education is not a matter of choosing the right device or the best software. The key elements for success were the teachers, school leaders and other decision makers with the vision and the ability to make the connection between students, computers and learning.[187]

School leadership and teacher support is key

Not all schools embrace or even use the range of technology that is available. One of the reasons for this can be a lack of teacher interest and/or awareness. The Committee heard repeatedly that one or perhaps several teachers with an aptitude or enthusiasm for ICT were primarily responsible for implementing some of the more innovative digital tech programs in a school. The support of the school's leadership was also a key factor in determining the scope of the technology used in a particular class and beyond.

At Merredin College, for example, underpinned by the strategic focus of the school, the primary school Deputy Principal Lynne Herbert shares her passion for learning with digital technology. As part of her role she runs 'Techie Brekkies' to help teachers learn about digital tools they can use in their classrooms. This is supported into the secondary school where digital technologies teacher Robyn Harrod has upgraded her own knowledge and qualifications and advocated for resources for digital technology.

At Corrigin District High School, a much smaller regional school, certain students had had an opportunity to do robotics in primary school with a particular teacher, but students who did not have that teacher missed out. Once in high school there was no continuation of the coding and robotics that had been learnt in primary school, with technology used for purely utilitarian purposes such as learning how to use a keyboard and Microsoft applications in English classes.

This critical inability to build on what was taught in primary school, where digital technology seemed to be widely embraced, was raised a number of times during the inquiry.

Corrigin's principal maintained that without a dedicated IT teacher students may not get exposed to technology, given the restrictions placed upon teachers to meet curriculum

186 Dr Jeremy Pagram, Edith Cowan University, *Transcript of Evidence*, 12 June 2019, p. 11.

187 Organisation for Economic Cooperation and Development, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*, OECD Publishing, Paris, 2016, p. 85.

content.[188] The Committee met a number of experienced teachers who were among the technology leaders in their schools.

Finding 17

Without a specific ICT strategy at the school, it appears opportunities for digital learning are often dependent on the knowledge and enthusiasm of a particular teacher. The level of school leadership in establishing an ICT focus and strategy determines the extent to which technology is implemented within a school.

Teachers are required to meet professional standards for use of ICT to gain registration in Western Australia. A graduate teacher is expected to implement teaching strategies for using ICT to expand curriculum learning opportunities, while a proficient teacher is expected to use effective teaching strategies to integrate ICT into learning and teaching programs to make selected content relevant and meaningful. [189]

The State Government's commitment of 3.3 million dollars over four years to provide a professional learning STEM program for more than 1000 teachers in lower socioeconomic public schools should ensure that all students receive equal teaching quality for digital learning.[190]

Education lecturer Dr Jeremy Pagram advised the Committee that Edith Cowan University had recognised the importance of teaching technology by providing pre-service teachers with a technology unit at the start of their course, rather than the end.[191]

Subsequent to their university training, pre-service teachers studying a nationally accredited Initial Teacher Education program have to meet a range of benchmarks in the area of ICT to meet requirements for teaching and to receive their qualification (Standards 1.2, 2.2, 2.6 and 4.5).[192] However, meeting the standards does not necessarily equip graduates for the school environment, as the Committee heard:

> There is a big disconnect from what is being taught in universities to pre-service teachers – they then get out in the real world and it is just not the same. I have had pre-service teachers who come to school and they do not know how to use Keynote or PowerPoint or put resources online, so their ICT general capabilities are weak.[193]

DoE Director General Lisa Rodgers agreed that despite pre-service teachers having met the required standards and passed performance assessment tests, they may have gaps in their learning. She said while the DoE did not have authority over the universities, she would

188 *Briefing*, 13 September 2019.

189 Teacher Registration Board of Western Australia, *Professional Standards for Teachers in Western Australia,* p. 4.

190 Hon Dave Kelly, Minister for Science and Hon Sue Ellery, Minister for Education and Training, *McGowan Government driving WA's future jobs, future skills*, media release, 20 May 2018.

191 *Transcript of Evidence*, 12 June 2019, pp. 8-9.

192 Teacher Registration Board of Western Australia, *Professional Standards for Teachers in Western Australia.*

193 Ms Shaloni Naik, Educational Computing Association of WA, *Transcript of Evidence*, 25 September 2019, p. 4.

confer with the deans of education about some of the things the department requires pre-service teachers to know, learn and understand.[194]

Finding 18

Teaching students are not necessarily graduating with the skills they need to use and teach with digital technologies throughout curriculum areas.

Recommendation 6

A goal of the Department of Education's ICT Vision Statement should be that teaching students graduate with skills to use and teach with digital technologies.

In-service teachers, particularly those who graduated long before digital technology was widely used, also require professional development opportunities, as Ms Rodgers recognised:

> We have got an ageing workforce. We do have a lot of teachers that are not as familiar with technology and the opportunity it affords as perhaps some of our younger teachers. So we have got an issue there in terms of upskilling that we are responding to.

The Department of Education has a number of initiatives that provide professional learning support for digital technologies, including Teachers Can Code (TCC). As at 20 June 2019, lead teachers had delivered more than 356 TCC workshops to over 4863 participants. Teacher Development Schools, which have teachers with expertise in digital technologies and STEM, also provide other teachers with opportunities to learn directly from their successful, evidence-based practices. This can be in the form of workshops, classroom observation, mentoring, online professional learning communities and tailored support. Seven Teacher Development Schools are also DigiTech Schools, providing professional support to teachers and schools specifically to implement the Digital Technologies curriculum.

> ***… much focus goes on the development and design of technological approaches, however implementation is everything.***
>
> *– Colin Pettit, Commissioner for Children and Young People*

To ensure teachers are meeting ICT needs, the DoE will now review every school over a period of three years and will be asking schools to participate in particular types of learning. As Mr Hale explained: 'We are now going back to the drawing board to strategise: how do we make sure that no school gets left behind?'[195]

> There are schools where, frankly, for at least some people in our system, the world has passed them by somewhat. When that is uncovered through that review process, then an agreed plan is created as to how the school will work its way

194 *Transcript of Evidence*, 25 September 2019, p. 14.
195 *Transcript of Evidence,* 12 June 2019, pp. 12-13.

> through that, either on their own if they have that capability … or with assistance … from Statewide Services.[196]

Two witnesses commented that one of the issues with self-directed professional development was that it was the same people routinely attending.[197] Dr Pagram suggested that the key to instilling capabilities was largely the responsibility of principals:

> in every school, there needs to be, first, a principal who asks, 'Why are you doing it that way?' and who knows what their teachers are doing and gives the little prod in the right direction, 'Well, you obviously need some help, some PD or whatever', and also having somebody who is showing how it is done, and that person needs to be supported with a bit of time.[198]

Mr Hale said that while the DoE still bore some responsibility, it was a key role of a school leader or principal to ensure staff were engaged in the way that they should be.[199] It was suggested numerous times throughout the inquiry that school leadership was fundamental to implementing digital technology across the curriculum, and we encountered examples of schools that had adopted a proactive stance. Ashdale Secondary College, for example, has been rolling out a structured professional development model to its staff of 160 teachers over the past six years.

> We have got them to embed that into their teaching program. If you went into a year 7 maths classroom, their program would actually have a column for their strategies to embed ICT. But again, not all schools are doing that, so all the innovation is happening only in the technology learning area.[200]

Thornlie Senior High School is another school that is working towards integrating digital technology, with the establishment of an ICT working party and an operational plan in action. The school is developing a whole school approach to teaching and learning ICT, designed to focus on the curriculum and improve student outcomes.[201] Professional learning is a key component.

Finding 19

In-service teacher participation in professional learning for digital technologies is limited, despite opportunities provided by the Department of Education. This can result in schools having very few teachers with up-to-date digital technologies skills.

Recommendation 7

A goal of the Department of Education's ICT Vision Statement should be that in-service teachers are able to demonstrate the skills to use and teach with digital technologies.

196 *Transcript of Evidence,* 12 June 2019, p. 13.
197 *ibid*.; Dr Jeremy Pagram, Edith Cowan University, *Transcript of Evidence*, 12 June 2019, p. 9.
198 *Transcript of Evidence*, 12 June 2019, p. 10.
199 Department of Education, *Transcript of Evidence*, 12 June 2019, p. 13.
200 Ms Shaloni Naik, Educational Computing Association of WA, *Transcript of Evidence*, 25 September 2019, p. 5.
201 *Briefing*, 16 September 2019.

Chapter 4

Considerations for the future

Educators and students alike need to 'dream-up', sand-pit, prototype, create proof-of-concept and rigorously apply existing and emerging technologies as tools to ensure fairer educational outcomes and futures.

From *Immersed in the Future: A Roadmap of Existing and Emerging Technologies for Career Exploration*

There is a lack of awareness around the potential for data harvesting

There are a number of safety and ethical considerations surrounding the use of digital technology in schools. Password protection of school devices and the use of personal devices on school grounds are governed by school policies, and students are made aware of issues such as cyber safety and appropriate online conduct as part of the ICT capability (which is one of the General Capabilities within the Western Australian Curriculum).[202]

But there are broader issues at stake concerning the use of software and apps and data harvesting. University of Newcastle Associate Professor Erica Southgate researches the application of new technology to education and was the lead author of the recent Commonwealth Government report, *Artificial Intelligence and Emerging Technologies in Schools*.[203]

She said that there were some key tensions in technology ethics, one of which was regulatory capture. This is where 'the provider of the goods or the services also provides information to the government on whether the goods or services are safe or ethical for use, and the government relies on that advice solely, with no independent advice given or experts to draw on'. She said:

> It is particularly an issue when artificial intelligence is infused into applications, because you cannot really tell it is there. For most artificial intelligence, you cannot tell that it is there; it is working in the background. It is harvesting lots of data. Often we do not now know what data we are giving away.[204]

Artificial intelligence, or AI, is an umbrella term that refers to 'a machine or computer program that uses human-like thinking to complete a task'. It can take many forms, including robots that mimic human interaction, robotic manufacturing systems and ubiquitous computing systems. Significantly, it can be 'invisibly infused into the everyday computing

202 School Curriculum and Standards Authority, *Information and communication technology capability*, accessed 28 October 2019, <https://scsa.wa.edu.au>

203 E Southgate, K Blackmore, S Pieschl, S Grimes, J McGuire and K Smithers, *Artificial intelligence and emerging technologies (virtual, augmented and mixed reality) in schools: A research report,* University of Newcastle, Australia, 2019.

204 *Transcript of Evidence*, 14 August 2019, p. 4.

application we use, such as internet search engines or the facial recognition tagging technology of social media applications'.[205]

Associate Professor Southgate said that the teachers did not know when they brought apps into the classroom that data was harvested and 'may be used for purposes that they never thought it should be used for.'[206] Indeed, when the question regarding security of data was raised by the Committee during school visits, the response given was always with reference to students' awareness of not sharing personal information online and password protection of devices.

The Department of Education (DoE) provides advice to schools via its *Students Online in Public Schools Policy and Procedures.*[207] The policy requires:

- students to be educated about risks associated with online activities and how to adopt protective online behavior
- supervision for students utilising online services at schools
- an assessment of the risk of third-party service providers before a service is implemented with students.[208]

The DoE Intranet also provides information about network security, links to websites about online safety, and the ability for a school to request a security test if there has been a suspected breach of policy of data integrity.

In relation to the third bullet point, the DoE is conducting a security and privacy risk assessment of commonly used services to help schools assess the risks associated with the use of third-party services.[209] This includes 'surveying the providers and establishing a consistent and thorough process. Schools will be provided advice on which services meet the Department's security and privacy standards and support for obtaining parental consent for the use of the services.' [210]

This addresses the call by the authors of *Artificial Intelligence and Emerging Technologies in Schools* for centralised policy advice and regulation to address the complexities of these applications, and in particular the potential for data harvesting.

Associate Professor Southgate described some of the ways in which data can be harvested:

205 E Southgate, K Blackmore, S Pieschl, S Grimes, J McGuire and K Smithers, *Short read: Artificial intelligence and school education*, University of Newcastle, Australia, 2019, p. 3.
206 *Transcript of Evidence*, 14 August 2019, p. 4.
207 Students online in Public Schools Policy and Procedures Department of Education accessed 28 October 2019, <http://det.wa.edu.au>
208 Department of Education, Letter, 25 October 2019, p. 6.
209 Third Party Service Providers of online applications are any organisations, consultants, or independent contractors who render an online service or product to the Department/Schools. These include applications such as Google Apps for Education, Seesaw Study Ladder and Mathletics.
210 Department of Education, Letter, 25 October 2019, p. 6.

> It is not so much that Google will come in and run a classroom, but Google will sell you a suite of learning products which all your students will use, and then their data will be harvested from that [211]

Vision learning, which is the way machines can scan environments, including our faces and our bodies, to harvest biometric data, was being used increasingly.

> That can be facial recognition, but it can also be things like how we type on a keyboard, or how we move in space when we have tracking technologies with virtual reality, or it could be eye gaze — for instance, where we direct our eyes. Increasingly, this type of technology can capture that information and we do now know it is being captured, and it can be used for various purposes. [212]

Associate Professor Southgate said that based on her understanding of Australian privacy legislation, and correspondence with the Privacy Commissioner, the collection of such biometric data would be considered as 'sensitive data', which (unlike European law) does not require permission or consent.

Despite that, Associate Professor Southgate calls into question the ethics behind such tracking, noting that a large technology company had promoted the concept of having cameras in classrooms to track student engagement. Associate Professor Southgate says there is no evidence that facial recognition technology can be used to track a person's emotional state; aside from this, use in this way would be an invasion of children's human rights. [213]

Another issue she felt warranted consideration is the male dominance of the computer sciences and the tech industry, with computer science degrees only having 13 to 15 per cent female participation. Associate Professor Southgate suggests this results in unintended gender bias in the design of applications which could have implications for a female's sense of safety. For example, virtual reality headsets do not allow the wearer to see outside of the screen, making some female students feel vulnerable and reluctant to put it on. This would be addressed by some newer headsets which have a camera that can be turned on so the wearer can see what is happening around them. [214]

Knowledge about artificial intelligence, virtual reality and similar digital technologies is in a continual state of change, leading the authors of *Artificial Intelligence and Emerging Technologies in Schools* to recommend teacher professional learning related to technical, social and ethico-legal aspects of the technologies be regularly updated. [215]

Demonstrating the point, the Australian Competition and Consumer Commission (ACCC) announced in October 2019 that it was suing Google for misleading consumers about its

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211 Associate Professor Erica Southgate, University of Newcastle, *Transcript of Evidence*, 14 August 2019, p. 5.
212 *ibid*., p. 4.
213 *ibid*., p. 6.
214 *ibid*., p. 9.
215 E Southgate, K Blackmore, S Pieschl, S Grimes, J McGuire and K Smithers, *Artificial intelligence and emerging technologies (virtual, augmented and mixed reality) in schools: A research report,* University of Newcastle, Australia, 2019, p. 84.

collection and use of personal location data. This follows on from the publication of the ACCC's Digital Platforms Inquiry report in July. Regulators in the US and Germany are also taking action against companies such as Google and Facebook for data harvesting and exploiting their users' data. Canada and Norway have also conducted investigations of the tech giants' practices.[216]

Finding 20

Schools seem generally unaware of the potential for data harvesting using artificial intelligence embedded into computing applications used in their classrooms.

Recommendation 8

The Department of Education's ICT Vision Statement must include principles related to technical, social and ethico-legal aspects of digital technologies and the regular training required for teachers on these aspects.

Digital technology has to prove its educational value

A number of contributors emphasised that the use of digital technology should be guided by its educational benefit to students and a knowledge of how to effectively incorporate it to achieve this.[217] As outlined in Chapter Two, children with disabilities can benefit from technologies that make their participation possible or at least easier, and students with learning difficulties are also able to participate in a way that keeps them engaged using ICT. However, in terms of students generally, the Director General of the DoE said research was 'inconclusive'. 'We cannot assume that technologies will enable students to improve faster. We know sometimes it does, but I do not think we are clear about how, and how to maximise that.'[218]

Analysis of PISA[219] data (from 2012) on the effects of ICT on students' outcomes shows a weak, and sometimes negative, association between the use of ICT in education and performance in mathematics and reading. The OECD says that this is partly explained by the focus on technology and connectivity by suppliers and policy makers,[220] rather than on pedagogy and learning outcomes.

Professor Stephen Winn, Dean of Education at Edith Cowan University, maintains 'there is a positive impact on student learning' when teachers are able to incorporate digital technology effectively in their daily teaching.[221]

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216 Katharine Kemp, 'The ACCC is suing Google over tracking users. Here's why it matters', *The Conversation* (web-based), accessed 30 October 2019, <theconversation.com>

217 Ms Lisa Rodgers, Department of Education, *Transcript of Evidence,* 25 September 2019, pp. 2, 5; Dr Jeremy Pagram, Edith Cowan University, *Transcript of Evidence*, 12 June 2019, p. 11; Associate Professor Erica Southgate, University of Newcastle, *Transcript of Evidence*, 14 August 2019, pp. 5, 8.

218 Ms Lisa Rodgers, Department of Education, *Transcript of Evidence,* 12 June 2019, p. 9.

219 Programme for International Student Assessment

220 Organisation for Economic Cooperation and Development, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*, OECD Publishing, Paris, 2016, pp.9-10.

221 Submission 7, Edith Cowan University.

DoE Statewide Services Executive Director Lindsay Hale said it was important when teaching digital technologies that teachers make explicit linkages to the curriculum and to foundation skills (e.g. literacy and numeracy). 'We do not want these digital technologies to just be a sort of bolt-on; we want it to be deeply embedded in a way that is mutually reinforcing of the learning.'[222]

Technology can amplify great teaching but great technology can't replace poor teaching.

– OECD, *Students, Computers and Learning: Making the Connection,* 2015

The OECD argues that while digital technologies cannot transform education by themselves, they can transform teaching and learning practices in schools and create new opportunities. Achieving this is 'more about integrating new types of instruction than overcoming technological barriers'. Digital technology could facilitate

> innovative pedagogic models, for example based on gaming, online laboratories and real-time assessment, which have been shown to improve higher-order thinking skills and conceptual understanding and in many cases have enhanced students' creativity, imagination and problem-solving skills.[223]

A number of contributors mentioned the importance of students interacting with digital technology as creators (or producers), rather than just consumers. Technology teacher Shaloni Naik said that this encouraged higher-order thinking.

> There are some classes that predominantly are consumers. However, if teachers are aware of how to utilise the tool and link it to all curriculum aspects, there can be a benefit. For example, some teachers think that Minecraft is just a game and you just build building blocks. But we have done a big sustainability report with students and we have taught them about sustainability. They have built eco-farms and houses, and they have worked collaboratively. We are at that point where we are trying to differentiate with classes whether they are consumers or producers of the content.[224]

Associate Professor Erica Southgate also talked about how students had used Minecraft to create their own worlds. While learning technology skills, they had also learnt collaborative skills, communication skills, problem-solving skills and research skills.

> It is about leveraging these technologies for that deeper learning. Of course, once you can master those competencies, you can take them anywhere and apply them to another problem or another thing that you need to learn, and that is what education should be about.[225]

Similarly, Macquarie University Associate Lecturer Rhett Loban said there was a need for students to be creators, and gave the example of 'modding'. This involves tinkering with the file contents and script or code structure of an existing game to make new game content or

222 *Transcript of Evidence,* 12 June 2019, p. 10.
223 Organisation for Economic Cooperation and Development, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*, OECD Publishing, Paris, 2016, p. 10.
224 Educational Computing Association of WA, *Transcript of Evidence*, 25 September 2019, p. 6.
225 *Transcript of Evidence*, 14 August 2019, p. 8.

a new version. The player is applying their own understanding and analysis of the topic of the game (which might be based on a historical event) which another student can then play.[226]

Another reason for the difficulty in demonstrating that ICT has positive educational outcomes is that there are few long-term studies – in some cases because the technology is too recent, but also because it is difficult to measure. As Kershaw (2016) points out, evidence of the benefits of ICT to learning in terms of student outcomes is sparse and measurement problematic, with causal effects not easily isolated.[227]

There are a few methodologically rigorous studies of using desktop virtual reality in STEM classrooms which have shown that it can assist in developing higher order thinking skills.[228] But research on the effects of *immersive* virtual reality (IVR) on children and their learning is in its early stages. Southgate et al. (2019) say that rigorous studies on the pedagogical potential of IVR are essential if it is to be used positively for creativity, collaboration and deep learning. Some emerging research is showing that IVR might be used to engage girls in computational thinking.[229]

I think we can do much more with the technology than just sit there and consume it. I think, for lots of learners, the creation and the doing and the seeing and the sharing is what is exciting — not just sitting there taking it in, in a more passive way. There is certainly a place for that within curriculum, but that is the lower hanging fruit.

– Associate Professor Erica Southgate

Research on augmented reality and viewer-based augmented reality had shown that it had some benefits to learning such as increased motivation, attention, collaboration and interactivity but there was a risk that students could become engrossed in the novelty of the technology at the expense of engaging with the learning tasks.[230]

A meta-analysis of the impact of laptop programs on students' academic achievement found that there was a positive effect in English, writing, mathematics, and science,[231] but, as acknowledged by the OECD, digital technology is not a 'magical solution to solve educational problems merely through provision'.[232] Planning in regard to deployment, tools and learning

226 *Transcript of Evidence*, 4 September 2019, p. 4.
227 Lorraine Kershaw, *Journeys towards expertise in technology-supported teaching*, PhD Thesis, Edith Cowan University, Perth, 2016, p. 16.
228 E Southgate, K Blackmore, S Pieschl, S Grimes, J McGuire and K Smithers, *Artificial intelligence and emerging technologies (virtual, augmented and mixed reality) in schools: A research report,* University of Newcastle, Australia, 2019, p. 54.
229 *ibid*., p. 59.
230 E Southgate, S Smith and H Cheers, *Immersed in the Future: A Roadmap of Existing and Emerging Technologies for Career Exploration*, DICE Report Series Number 3, 2016, p. 18.
231 Binbin Zheng, Mark Warschauer, Chin-Hsi Lin, Chi Chang, 'Learning in One-to-One Laptop Environments: A Meta-Analysis and Research Synthesis', *Review of Educational Research*, vol. 86, issue 4, 1 December 2016, p. 1052-1084.
232 OECD, *Students, Computers and Learning: Making the Connection,* PISA, OECD Publishing, 2015, p. 6.

is vital to ensure that today's equivalent of the pencil is a useful tool, making the DoE's ICT Vision Statement an imperative.

Finding 21

Education leaders are aware of the need to ensure that digital technology is being integrated into the curriculum to deliver desired learning outcomes, and not just for the sake of using it. Creating rather than just consuming is considered important.

Recommendation 9

The Department of Education's ICT Vision Statement must clearly articulate a method for integrating digital technology into the curriculum.

As discussed in Chapter Three, the DoE could also be providing a greater degree of guidance on the way schools are purchasing additional internet services.

The DoE ICT Vision Statement needs to address whether it will provide schools with a wider range of software, ensuring that students and teachers have free access to a useful range of tools that are available in other jurisdictions.

Victoria's secondary school software suite contains Wolfram Suite, which includes applications for image processing, geometry, data science and visualisation, physical modelling and simulation, coding, and database queries; ClickView, which contains educational interactive videos and pay-TV content; Lynda.com, which provides access to a library of more than 200 unique videos to develop software skills; Sibelius, which assists music students with composition and orchestration; and Comic Life, a visual literacy tool for creating comics and storyboards. Excluding the software provided by the Schools of Special Educational Needs, the DoE appears to provide only Connect, Office 365 and the WebEx platform.

The New South Wales Department of Education operates a lending library of software and hardware kits (called STEMshare) so that schools can try before them before they commit to a purchase.

While the DoE's Statewide Services has a Resource and Information Centre which all public school teachers may access, there is no identical software or hardware lending service. On request, the department's Regional Laboratory Technician Group will lend schools specialised STEM equipment such as data-logging accessories and robotics kits.[233]

ECAWA secondary school coordinator Shaloni Naik said the curriculum was implemented in 2018 with very little support to teachers. In the absence of an ICT vision, neither the DoE nor the Curriculum Council has provided enough guidance on how to implement the ICT capability or provided resources to download. Teachers have no choice but to source resources from external agencies in other states.[234]

233 Department of Education, Letter, 25 October 2019, p. 8.
234 Educational Computing Association of WA, *Transcript of Evidence*, 25 September 2019, p. 2.

Recommendation 10

The Department of Education must outline in its ICT Vision Statement how it will provide more support to secondary teachers in the form of software for all subjects and online resources for teaching the ICT capability.

Leadership is required for the potential of digital technology to be fully realised

One of the questions this inquiry has considered is whether it is possible to live anywhere and still be able to learn anything at any time within the context of the WA education system. While the technology exists to enable this, infrastructure, connectivity and bandwidth issues mean that this is a tenuous goal not yet fully realisable.

Curriculum content development and learning management platforms may also not be at a stage that enables this. Some subjects are able to be delivered quite easily. Others, particularly arts-based subjects with practical components, are challenging to deliver and assess. While there is the capacity to access online classes and materials at a location other than the school campus during hours other than school hours, there is more to digital learning than accessing digitised documents or a PowerPoint presentation.

Catholic Education WA sees a future where students will be able to select courses and instructors based on their interests and proficiency level, regardless of where the expertise and delivery exists across the Catholic system. Others, such as Erica Southgate and Rhett Loban, see a future in which students can explore and understand each other's cultures in virtual worlds. It could be possible for technology to open doors to learning and engagement for students who think and learn best in non-traditional ways, enabling them to demonstrate knowledge and competency using methods other than writing an essay – perhaps by making a virtual reality game using Minecraft or creating a video.

Having a facility to deliver distance education classes with real teachers (e.g. WebEx) and a learning management system (LMS) such as Connect or Moodle to deliver and manage course content and assessments is obviously necessary for expanding the boundaries of where learning takes place; however, it does not necessarily mean that innovative digital learning is occurring.

According to Sydney-based edtech company Smart Sparrow, students are now demanding more from an LMS than just content posted online. They want engaging and more personalised digital learning experiences. The students that the Committee spoke to felt this was unachievable give the constraints of the LMS. Smart Sparrow said the software architecture needed to change if students and teachers were going to be able to use an LMS for more than storing content, uploading assignments and creating or completing quizzes.[235]

A VET sector report on engaging students notes that there is variability of practice even within the constraints of an LMS, with some teachers uploading video material, games and

235 Dror Ben-Naim, *CEO Blog: Inspiring the Next Wave in Digital Learning*, 14 November 2018, accessed 20 June 2019, <https://www.smartsparrow.com>

sound files, and others simply uploading text-based documents and course outlines, replicating existing paper-based approaches.[236]

Smart Sparrow courseware designer and former teacher Matthew Bennett wrote a blog about his frustrations of using an LMS to teach English as a Second Language to biology students. While he had envisaged creating lessons where the students could be placed in life-like situations and anticipated being able to provide immediate feedback to the questions they had answered, he gave up on trying to develop 'complicated' material.

> with the tools provided to me, there was no simple way for me to create a visually appealing sequence of content. More importantly, content with which my students could interact in different ways – answer questions, and receive immediate, meaningful feedback (more than just "correct" or "incorrect") on the choices they made ... It was simply too difficult and time consuming to customise the online content in the way I wanted, for the gain I felt my students would get out of it. I decided to use the LMS for simple things (quizzes/pre-reading/etc.), and let go of my vision of amazing, well-designed online lessons.[237]

In search of greater flexibility, some schools use other platforms such as Google Classroom in preference to the DoE-provided Connect platform. EduGrowth Managing Director David Linke described a new LMS called Quitch, developed by Swinburne University, originally designed as a mobile phone platform. It uses elements of social media such as instant communication and instant support.[238] A capacity for instant messaging would address the criticisms teachers and (especially) students made in relation to Connect.

While progress has been made in regard to learning anywhere, anytime innovations, Home School WA representatives said that there were some parents in the home-schooling community who felt that schools were behind the times in regard to the use of technology in the classroom. At home, their children were able to access an array of learning tools and online resources via the internet, but at school 'it is like it was 50 years ago in some ways'.[239]

It is clear that leadership is critical to the ambition outlined by the OECD, where:

> the successful integration of technology in education is not so much a matter of choosing the right device, the right amount of time to spend with it, the best software or the right digital textbook. The key elements for success are the teachers, school leaders and other decision makers who have the vision, and the ability, to make the connection between students, computers and learning.[240]

Similarly, the authors of the *Immersed in the Future* report said that their 'roadmap' was a call for all those involved in education to act now and to actively participate in developing

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236 Lucas Walsh, Barbara Lemon, Rosalyn Black et al., *The role of technology in engaging disengaged youth: final report*, Australian Flexible Learning Network, Commonwealth of Australia, 2011, p. 12.

237 Matthew Bennett, *Overcoming the Limitations of Online Teaching*, 26 March 2019, accessed 2 October 2019, <www.smartsparrow.com>

238 *Transcript of Evidence*, 4 September 2019, p. 6.

239 Ms Saani Bennetts, Home Education WA, *Transcript of Evidence*, 25 September 2019, pp. 6-8.

240 Organisation for Economic Cooperation and Development, *Innovating Education and Educating for Innovation: The Power of Digital Technologies and Skills*, OECD Publishing, Paris, 2016, p.85.

ideas and applications for using new and emerging technologies, to create deeper disciplinary and interdisciplinary learning and more authentic connection to post-school education and the world of work.[241]

While schools in the WA system are largely autonomous, there is a need for leadership from the top. CEWA, in outlining its cohesive strategy for the future, identified that many WA Catholic schools have also operated as autonomous units, providing digital infrastructure, resources and technical support independently of each other. As such, initiatives were largely isolated to individual school sites and dependent on a few key staff to implement and resource.[242]

The Director General of Education Lisa Rodgers correctly identified the need for balance between independence and the mutual interests of students:

> I would like to, in my tenure, think a bit more about how we support schools to be just a little bit more connected — maintain their autonomy, but let us get some best practice, both in terms of the technology and the bandwidth … but (also) the learning and the practice … I think we just need to build a bit more of that connected autonomy in the system.[243]

To benefit the state-wide student body, to ensure equity in delivery and to bridge any digital disadvantage, the DoE's yet-to-released ICT Vision Statement must assist schools to embrace the elements of digital technology, creating connected learners who grasp the opportunities to learn in a variety of ways, according to their needs, abilities and future goals.

Recommendation 11

The Department of Education's ICT Vision Statement must clearly define a shared goal for all students to learn with, as well as about, digital technology.

MS J.M. FREEMAN, MLA
CHAIR

241 E Southgate, S Smith and H Cheers, *Immersed in the Future: A Roadmap of Existing and Emerging Technologies for Career Exploration*, DICE Report Series Number 3, 2016, p. 31.
242 Submission 2, Catholic Education Western Australia, p. 13.
243 *Transcript of Evidence*, 25 September 2019, p. 2.

Appendix One

Committee's functions and powers

The functions of the Committee are to review and report to the Assembly on:

a) the outcomes and administration of the departments within the Committee's portfolio responsibilities;

b) annual reports of government departments laid on the Table of the House;

c) the adequacy of legislation and regulations within its jurisdiction; and

d) any matters referred to it by the Assembly including a bill, motion, petition, vote or expenditure, other financial matter, report or paper.

At the commencement of each Parliament and as often thereafter as the Speaker considers necessary, the Speaker will determine and table a schedule showing the portfolio responsibilities for each committee. Annual reports of government departments and authorities tabled in the Assembly will stand referred to the relevant committee for any inquiry the committee may make.

Whenever a committee receives or determines for itself fresh or amended terms of reference, the committee will forward them to each standing and select committee of the Assembly and Joint Committee of the Assembly and Council. The Speaker will announce them to the Assembly at the next opportunity and arrange for them to be placed on the notice boards of the Assembly.

Appendix Two

Inquiry process

The Education and Health Standing Committee resolved to conduct an inquiry into digital innovation in secondary education in June 2019. The inquiry terms of reference were announced by the Speaker of the Legislative Assembly on 26 June 2019 and the details placed on the Committee's web page.

The Committee wrote to 34 stakeholders inviting submissions, and also advertised for submissions in *The West Australian* newspaper on 6 July 2019. The inquiry was announced via the Legislative Assembly's Twitter account and details were posted on The Parliament of Western Australia Facebook page. The Committee received 14 submissions (see Appendix Four).

Evidence was also gathered in seven hearings and five briefings. Parties who provided oral evidence to the Committee are listed at Appendix Five. Three of the hearings were conducted by video link due to the witnesses being located in the eastern states.

During the inquiry period, the Committee visited secondary schools in the regional Western Australian towns of Merredin and Corrigin as well as two schools in the metropolitan area, Cecil Andrews College and Thornlie Senior High School. In addition to the school principals, the committee members were able to speak to a number of teachers and students at the schools.

The Committee also visited the School of Isolated and Distance Education in Leederville, touring the facility and meeting with the principal and the head of Online Teaching and Learning.

Before the announcement of the inquiry, the Committee also held three hearings which assisted in determining the scope of the inquiry. These were with the Department of Education, Charles Darwin University senior lecturer in E-Learning Dr Jon Mason (via video link) and Edith Cowan University senior lecturer in the School of Education Dr Jeremy Pagram. The Committee's visit to Hale School in 2018 to learn about the activities of the school's Institute of Innovation and Research and use of technology also informed this inquiry.

The information gathered from the site visits, briefings, hearings, submissions and scoping phase evidence is the basis of this report. The Committee remains grateful to all those who made contributions.

Appendix Three

Submissions received

No.	Name	Position	Organisation
1	Mr Mathew Johnson	Manager, Therapy and Clinical Services – School Age	Autism Association of Western Australia
2	Dr Debra Sayce	Executive Director	Catholic Education Western Australia
3	Mr Colin Pettit	Commissioner	Commissioner for Children and Young People Western Australia
4	Ms Zina Cordery	Digital technologies and educational technology lecturer	Not submitted on behalf of an organisation
5 & 5A	Dr John Davis	Acting Chief Executive Officer	Stronger Smarter Institute
6	Mr Stephen Baxter	Deputy Director General, Schools	Department of Education
7	Professor Stephen Winn	Executive Dean, School of Education	Edith Cowan University
8	Cr Quentin Davies	Chair	NEWROC (North Eastern Wheatbelt Regional Organisation of Councils)
9	Professor Chris Matthews	Chair	Aboriginal and Torres Strait Islander Mathematics Alliance (ATSIMA)
10	Ms Rebecca Brown	Director General	Department of Jobs, Tourism, Science and Innovation
11	Mr Dean Tollis	Chair	Gifted WA
12	Ms Mary Mulcahy	Director	CSIRO Education and Outreach
13	Ms Ann-Marie Ryan	Industry Manager, Creative Industries and Information Communications Technology	FutureNow Creative and Leisure Industries Training Council
14	Mr Jason Mills	Government Relations, Corporate Affairs	Telstra

Appendix Four

Hearings and briefings

Hearings

Date	Name	Position	Organisation
14 August 2019	Associate Professor Erica Southgate	Associate Professor, School of Education	University of Newcastle
4 September 2019	Mr David Linke	Managing Director	EduGrowth
	Mr Rhett Loban	Academic	Macquarie University
18 September 2019	Ms Jane McNamara	Head of nbn local WA	NBN Co
	Mr Simon Lawton	Industry Consultant – Business Segment	
25 September 2019	Mr Michael King	President	Educational Computing Association of WA (ECAWA)
	Ms Shaloni Naik	Secondary school coordinator	
25 September 2019	Ms Saani Bennetts	Committee member	Home Education WA
	Ms Christina Kardol	Committee member	
25 September 2019	Ms Lisa Rodgers	Director General	Department of Education
	Mr Martin Clery	Assistant Executive Director, Statewide Services	
	Mr David Dans	Chief Information Officer	
	Mr Jeff Stone	Principal, School of Special Educational Needs: Behaviour and Engagement	
	Mr Caleb Jones	Principal, School of Special Educational Needs: Medical and Mental Health	

Briefings

Date	Name	Position	Organisation
7 August 2019	Mr Noel Chamberlain	Principal	School of Isolated and Distance Education
	Mr Ross Manson	Head of Online Teaching and Learning	
12 September 2019	Mr Albert Huts	Principal	Merredin College
	Mr David O'Neill	Deputy Principal	
	Ms Lynne Herbert	Deputy Principal, Primary	
	Ms Robyn Harrod	Digital technology teacher	
	Ms Natalie Pirovich	Head of learning area (Arts)	
	Mr Sam Dawson	Humanities and social sciences teacher	
13 September 2019	Mr Bruce Fraser	Principal	Corrigin District High School
	Ms Isabella Carlse	Secondary science and English teacher	
	Mitchell, Harry, Kasey, Tegan, Chloe, Sam, Darcy, Emily	Secondary students	
16 September 2019	Ms Stella Jinman	Principal	Cecil Andrews College
	Mr Stuart Jones	Deputy Principal	
	Mr Nathan Morton	Deputy Principal	
	Ms Amanda Lean	STEM teacher	
16 September 2019	Ms Donna McDonald	Principal	Thornlie Senior High School
	Mr David De Meo	Deputy Principal	
	Mr David Donnelly	Teacher in charge, digital technology	
	Mr Chee Liew	Mathematics teacher	
	Ms Lisa Knight	Humanities and social sciences teacher	
	Ms Michelle Manolas	P&C president, robotics club coordinator	
	Ms Tracey Nelson	P&C vice president, robotics club coordinator	
	Thomas, Connor, Jasmine, Rungrung, Jessica, Bella, Mason, Dev, Kydenne	Students	

Appendix Five

Acronyms

AR	Augmented Reality
CEWA	Catholic Education Western Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DoE	Department of Education
EAL/D	English as an additional language/dialect
HMD	Head-mounted display
IAR	Immersive Augmented Reality
ICILS	International Computer and Information Literacy Study
ICPA Australia	Isolated Children's Parents' Association of Australia
ICT	Information and Communications Technology
IDX	Indigenous Digital Excellence
LBOTE	Language background other than English
LMS	Learning Management System
MR	Mixed Reality
NCIE	National Centre for Indigenous Excellence
NEWROC	North Eastern Wheatbelt Regional Organisation of Councils
OECD	Organisation for Economic Co-operation and Development
PISA	Program for International Student Assessment
SIDE	School of Isolated and Distance Education
STEAM	Science, technology, engineering, arts and maths
STEM	Science, technology, engineering and maths
WA	Western Australia

Appendix Six

Glossary

Augmented reality (AR)	A technology that replicates, enhances or overlays extra information about the real-world environment, using computer-generated data such as global positioning systems (GPS), sound, videos and images. Examples include a car windshield with a heads-up display (HUD) that projects three-dimensional navigation information and virtual lanes; and a swimming telecast using a line to indicate the position of the record holder in relation to the actual swimmers in the race.
Digital reality (DR)	An umbrella term for augmented reality, virtual reality, mixed reality, 360°, and immersive technologies.
Gamification	The application of game-design elements and game principles in non-game contexts.
Haptics	Artificial haptic sensations can present information to users, help them complete a task, augment or replace the other senses, and add immersiveness and realism to virtual interactions. Haptic technology, also known as kinaesthetic communication or 3D touch, refers to any technology that can create an experience of touch by applying forces, vibrations, or motions to the user.
Immersive	A deeply engaging, multisensory, digital experience, which can be delivered using VR, AR, 360° video, mixed reality, and other technologies.
Learning Management System	A learning management system is a software application for the administration, documentation, tracking, reporting, and delivery of educational courses, training programs, or learning and development programs.
Mixed reality (MR)	Seamlessly blends the user's real-world environment and digitally created content in a way that allows both environments to coexist and interact. Utilises advanced sensors for spatial awareness and gesture recognition.
Virtual reality (VR)	Creates a fully rendered digital environment that replaces the user's real-world environment. Features body- and motion-tracking capabilities.
Universal design for Learning (UDL)	UDL is a framework for instruction based on principles that guides the design and development of curriculum that can accommodate individual learning differences. UDL emphasises equal access to curriculum by all students.

Appendix Seven

Secondary schools/sites using the Bring Your Own Device program

School/site
Albany SHS
Australind SHS
Bridgetown HS
Broome SHS
Bruce Rock DHS
Bullsbrook College
Bunbury SHS
Carnarvon CC
Christmas Island DHS
Dalyellup College
Dowerin DHS
Eastern Goldfields College
Eaton CC
Geraldton SHS
Halls Creek DHS
Harvey SHS
Hedland SHS
Jurien Bay DHS
Karratha SHS
Manea Senior College
Manjimup SHS
Margaret River SHS
Merredin College
Mt Barker Community College
Mukinbudin DHS
Nannup DHS
Newton Moore SHS
Northam SHS
Northcliffe DHS
One Arm Point RCS
Quairading DHS
Roebourne DHS
Western Australia College of Agriculture - Denmark
Western Australia College of Agriculture - Harvey
Western Australia College of Agriculture - Narrogin
Wagin DHS
Applecross SHS
Armadale ESC
Ashdale Secondary College
Atwell College
Aveley Secondary College
Baldivis Secondary College
Belridge Secondary College
Byford Secondary College
Canning Vale College
Cecil Andrews College
Churchlands SHS
Comet Bay College
Como Secondary College

Darling Range Sports College
Duncraig SHS
Fremantle College
Gilmore College
Greenwood College
Halls Head College ESC
Halls Head College
Harrisdale SHS
John Forrest Secondary College
John Tonkin College
Joseph Banks Secondary College
Kalamunda SHS
Kent Street SHS
Kiara College
Kinross College
Leeming SHS
Melville SHS
Mindarie Senior College
Mt Lawley SHS
North Lake Senior Campus
Ocean Reef SHS
Perth Modern School
Rossmoyne SHS
Sevenoaks Senior College
Shenton College Deaf EC
Shenton College
Southern River College
School of Special Education Needs: Behaviour & Engagement
Thornlie SHS
Warnbro Community High School ESC
Willetton SHS
Yanchep Secondary College
Albany SHS
Australind SHS
Bridgetown HS

Source: Computer Census 2019 as at 30 September 2019

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