Trends in the Digitalization of K-12 Schools: The Australian Perspective

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Abstract

Although Australian children have plenty of access to digital technologies in school, a common perception is that this hasn't made a difference to the quality of education in Australia. In fact, it is widely considered that educational standards are in decline and schools are failing to teach children the skills that they will need for the future. The Australian Government, however, do recognize that the road to digitalization is long and they have invested in a new digital technologies curriculum and the provision of equipment and teacher professional development to support this goal. While this is a positive move and exciting projects are being implemented in schools, there is less focus on educational research in this area. This is a missed opportunity because research outcomes can provide an additional level of credibility that is required to justify why 'new literacies' are essential in a contemporary school curriculum.

Keywords: digital technologies, curriculum, digitalization

Introduction

This paper is derived from a keynote address at the "Recent trends in the digitalization of the Nordic K-12 schools" symposium. It is a position paper that reflects on trends of digitalization of schools from an Australian perspective. It is informed from document analysis (Bowen, 2009) of relevant policy documents, websites, project reports, media releases and research relating to the topic.

There are a number of challenges relating to the digitalization of schools and it seems that global issues also are evident in Australia, despite the remote location. In general, it seems that education is not in a comfortable space and is subject to pressure and twist, as children emerge from school in a very different place to the one that was occupied by their parents (Hatch, 2009). These children are sometimes labeled 'the digital generation' as they were born in a time when digital technologies were considered to be pervasive across society but this doesn't mean that these technologies are necessarily adopted and commonplace in their school (Cinque & Brown, 2015).

Australia has a technocentric society and so it is not surprising that Australian schools are well resourced with computers and other digital tools. The OECD

(2015) identified that computers are more prevalent in Australian schools than other countries. The OECD reported that the 2012 PISA results revealed that in Australia, every 15-year-old had individual access to a computer at school and 93.7% of students used computers for their school work (p. 20). This skew might suggest that Australia should be leading in the use of computers for learning but does the provision of equipment necessarily lead to innovate use and better outcomes? This paper reports on the use of digital technologies in Australian education and reflects on the implications.

Schooling in Australia

The population of Australia is nudging 25 million. Four million of these are children and just under 300,000 are teachers, from almost 9,500 schools (ABS, 2017). Most children have access to non-compulsory early years education before the age of 5, attend formal schooling between the age of 5 or 6 until 15 or 16 and then senior high school or college until 17 or 18, with 13 years of schooling in total (DET, 2017a). Australia is divided into six states and two territories and up until recent times each State or Territory government largely managed the funding and curriculum structures for their own schools. This meant that there were eight different systems with varied starting and leaving ages and often quite different curriculum guidelines. This has been changing over the last decade, as the Federal Government become progressively more involved with the education of the nation's children. In 2009, the national Early Years Learning Framework (EYLF) (DEEWR, 2009) commenced for the preschool years (0-5) and then a nationwide curriculum for primary and secondary schools (5-16 years old) called 'The Australian Curriculum' was introduced in 2014 (ACARA, 2017a). This curriculum is currently being rolled out by subject areas and will largely replace the state curriculums by 2019.

The Federal Government has also been responsible for introducing measures perceived to lift quality in education. In 2008, a testing regime called the National Assessment Program – Literacy and Numeracy (NAPLAN) commenced (ACARA, 2017b). The NAPLAN has a series of tests focused on core literacies and is administered at Years 3, 5, 7 and 9. A new phonics screening test is also planned for Year 1 children (6-7 years old). The school results from the NAPLAN tests are published on the *My School Website* (ACARA, 2017c). This website provides families and the general public with demographic information and performance data from all schools in Australia.

Challenges in Education in Australia

While the Australian education system has developed progressively since the turn of the century, the rhetoric about outcomes is not particularly positive. There are a number of issues that cause discontent and there are two that are particularly damning. These are that:

1. Educational standards are falling and the performance outcomes of students are in decline.
2. The education system is failing to teach children the skills that they will need for the future

These two concerns weigh heavily on educators in Australia and impact significantly on decisions made with regards to policy and practice. They also have implications for how digital technologies can be used to extend and innovate curriculum and pedagogy.

Standards in decline

A key source that is referred to when discussing the decline of standards is the Programme for International Student Assessment (PISA). PISA tests have been conducted by the Organization for Economic Co-operation and Development (OECD) since 2000. The tests are administered to a sample of 15 years olds in 59 countries and measure performance in reading, mathematics and science. A search on Australia from the "Compare your Country" website (OECD, 2017) provides some seemingly condemning evidence (see Figure 1).
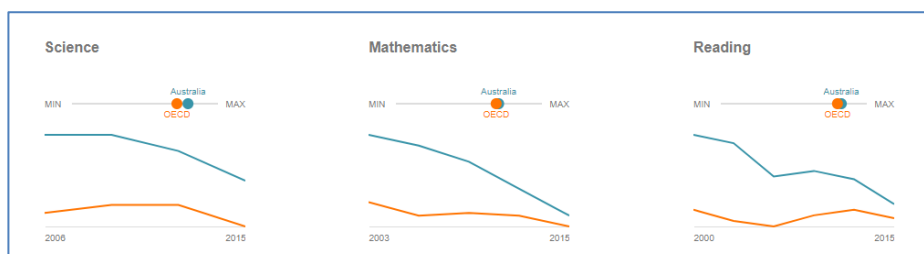

Figure 1: Average PISA performance of Australian students (OECD, 2017)

The scores of students in Australia in science, mathematics and reading have dropped in every PISA data collection (apart from a small upward trend in reading in 2006). Overall, the average PISA score for an Australian student dropped from 527 to 510 between 2006 and 2015 (Thomson, De Bortoli & Underwood, 2016). Although many countries have seen similar declines, a few countries, such as Singapore, have avoided this trend and have managed to improve their scores on all tests. Consequently, Australia has slipped in the world rankings, dropping from 13 to 16 in reading and from 19 to 24 in mathematics (Thomson et al, 2016).

Further investigation of this website reveals that the news is not all bad. Australia's world ranking for Science has actually improved slightly, from 16 in 2012 to 14 in 2015 and Australia is still above OECD averages in all three categories. This, however, is largely ignored by the popular press and headlines such as "Australia's 'tolerance of failure' behind declining PISA results" (Singhal, 2017) and "Australian schools are in 'absolute decline' globally" (Hunjan & Bloomer, 2016) paint a gloomy picture of the capacity of Australian children and the failure of the Australian education system.

Another reason for dissatisfaction with the Australian education system is the outcomes from the NAPLAN testing cycle. The introduction of NAPLAN in 2008 was largely justified as a mechanism to address declining literacy and numeracy standards in Australia. However, despite extensive funding and a large proportion of time being allocated for test preparation and testing, results have shown no significant improvements (Dodd, 2017).

This type of stagnation is ominous for educators. Typically, teachers get blamed for any drop in standards and through association, teacher education providers are criticized for the inadequate preparation of teachers. This implication is evident in a report from the Teacher Education Minister Advisory Group (TEMAG) called "Action Now: Classroom Ready Teachers" (TEMAG, 2015). The TEMAG report offered a number of externally imposed measures to address perceived shortfalls in teacher education. This includes the Literacy and Numeracy Test for Initial Teacher Education (LANTITE) (ACER, 2017), a hurdle required for students to graduate and the Teacher Performance Assessment (TPA), an extended written submission completed in the final year of study in order to demonstrate the application of the 37 Australian Professional Standards for Teachers (AITSL, 2017) at the graduate level.

When an education system, either at a school or a university level, is subject to mandates such as these, a common response is to 'teach to the test'. This means that any peripheral or extended activity is cut from the curriculum, in a 'back to basics' approach. While there is some evidence that schools and universities in Australia may have considered this approach (Polesel, Rice & Dulfer, 2014) the second challenge, 'preparing learners for the future', means that simply returning to old ways isn't an option (Riddle, 2015). The ever-expanding influence of technology means that learners need engage with new content and this requires educators to offer something more than the traditional curriculum.

Skills for the Future

The second challenge for educators is the perception that much of the content taught in classrooms is outdated and that children are not being prepared for work and life in the future. As governments and the commercial sector look towards perceived requirements, it seems evident that not enough Australian school leavers are choosing Science, Technology, Engineering and Mathematics (STEM) as career options to sustain development (Chapman & Vivian, 2017). As an indicator, in 2016, 18% of university graduates were from STEM fields in comparison to 35% from Singapore and 47% in China (Segal, 2016). While the reasons for this are likely to be complex, a simple attribution is that schools in Australia do not do enough to engage children with STEM concepts (Prinsley & Johnston, 2015). Further, it is anticipated that digital technologies will play an ever-increasing role in any future scenario and so schools need to do more to teach children about how use technologies in STEM learning (Littlejohn & Hunter, 2016).

This renewed focus on using technologies for authentic purposes is welcomed by educators who are promoting the digitalization of schools. It is interesting, however, that the drive for an increased emphasis on technologies in education from a business perspective may concentrate on narrow, employable skills in the industry rather than a broader, problem solving based approach. In particular, there is a call to teach computer programming or 'coding' to all children from an early age (Brewster, 2015). While computer coding is a very important part of the technological transformation, it certainly isn't the only skill that will be required to advance digital technologies in the future (Scott, 2015). It is important to recognize that a wide range of skills are required and we need people with different expertise in order to work in teams to implement digital solutions.

Improving literacies

Although the two issues outlined here might be seen to be in direct competition in terms of school priorities, they can actually be closely aligned under the banner of Literacy. Traditional literacy encompasses aspects of reading and writing, as addressed in the NAPLAN and PISA, but contemporary definitions of literacy are broader. The 'new' literacies (Lankshear & Knoebel, 2011; Knoebel & Kalman, 2016) incorporate digital literacies and the use of technology for a wide range of purposes. Reading and writing is not redundant in this context but they need to be applied in contemporary ways. This means that schools need to deliberately teach children to be literate in contexts where they can apply these skills for current and future purposes.

Digital Technologies in the Australian Curriculum

Prior to the Australian Curriculum, teaching with and about digital technologies was overlaid in other curriculum areas. The Australian Curriculum offers Digital Technologies as a subject within a curriculum area in its own right (ACARA, 2017a). The Technologies Curriculum Area was endorsed in 2015 and was

optional for implementation in 2016/17. In 2018, Technologies will be a required area for children from Foundation (5/6 years) until Year 8 (13/14 years). Schools will then decide what and how Technologies subjects will be offered for the remaining years. The Technologies area is divided into two subjects, Design and Technology and Digital Technologies. While these are distinct, they are closely related and are drawn together by concepts such as computational thinking, project design and management and creative problem-solving (see Figure 2).
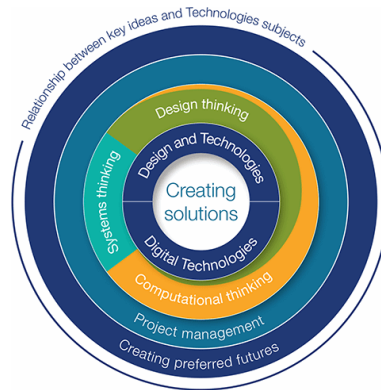

Figure 2: Map of the key ideas in the Australian Curriculum Technologies Area (ACARA, 2017a)

The Digital Technologies subject is particularly relevant when considering the digitalization of schools and the development of digital technologies skills. The curriculum content of this subject is divided in to two strands: knowledge and understanding; processes and production skills. These strands cover a broad spectrum of relevant content, including digital system components, representation of data, managing data and creating digital solutions. Coding, of course, is covered thoroughly, however, the subject is not limited only to coding as it embraces a much wider perspective of the application of digital technology in society.

In addition to the curriculum areas, the Australian Curriculum offers a number "General Capabilities". A general capability encompasses skills, knowledge and attitudes required across all curriculum areas. One of these capabilities is Information and Communication Technologies (ICT) and it is specified that students "learn to use ICT effectively and appropriately to access, create and communicate information and ideas, solve problems and work collaboratively in all learning areas" (ACARA, 2017a: np). This means that teachers are required to embed ICT across classes into all curriculum areas. The key ideas from the ICT capability are shown in Figure 3.
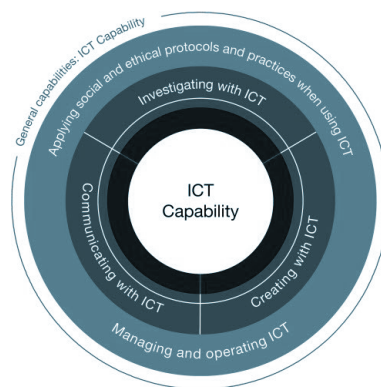

Figure 3: Key ideas from the Australian Curriculum ICT Capability (ACARA, 2017a)

Another important trend that incorporates digital technologies is STEM education. STEM incorporates material from the four STEM areas (Science, Technology, Engineering and Mathematics) but it is actually more than simply teaching this content. STEM requires the conjunction of these ideas, where learners find solutions to 'wicked' problems and these solutions are enacted in practical projects (Finger, 2018). The interest in STEM is worldwide and in Australia the National STEM School Education Strategy (Education Council, 2015) outlines the national approach for 2016-2026. In anticipation of this, the STEM connections project (ACARA, 2016) provided illustrations of practice to show how the Australian Curriculum could be enacted with a STEM approach for Years 9 and 10.

Advocates for the use digital technologies in schools are delighted by this progressive development in the school curriculum in Australia (Speranza, 2015). Computers and associated devices have been used by innovative teachers since the 1980s and it is affirming that now, after 30 years, the curriculum clearly incorporates digital technologies as both a learning area and an essential capability across the curriculum. The challenge is now to ensure that this advancement is enacted and that children learn to use digital technologies in deep and meaningful ways.

Funding and resourcing digitalization

It is unlikely that any new initiative will be implemented successfully unless it is properly resourced and funded. Fortunately, there appears to be quite a bit of funding available to support Australian schools with digital technologies innovation at present (Prinsley & Johnston, 2015). The Federal Government funds a number of initiatives under a program called the National Innovation and Science Agenda (NISA). This includes the Digital Literacies School Grant (DLSG), available across 2016-2018, and designed to encourage new ways of implementing digital technologies across the Australia Curriculum (DET, 2017b). This type of funding has enabled schools to buy technological equipment previously beyond their reach. Schools are certainly trying new things and the popular press reports on a flurry of projects focused on high-end equipment including robotics, drones and 3D printers.

Of course, just because teachers have access to fancy equipment, it doesn't mean that they will then be able to use it in meaningful ways to enhance teaching and learning (Knoebel & Kalman, 2016). Fortunately, there has been recognition of this in the funding provision, and teacher development has been incorporated. The DLSG specifies professional development for school leaders and teachers as a key priority. Additionally, the Federal Government have funded the Digital Technologies Hub (Education Services Australia, 2017), an extensive support site, to help teachers to implement the Australian Curriculum Digital Technologies Curriculum. Further, the Computer Science Education Research (CSER) Group based at the University of Adelaide provide the Digital Technologies Education Program (CSER, 2017). This program is funded collaboratively by Google Australia and the NISA and provides several teacher support initiatives. The flagship of this program is a series of free online MOOC courses designed to support teachers across Australia with the implementation of the Australian Digital Technologies Curriculum.

Opportunities for research

The stated aim of the DSLG is to develop best practice models of implementation and to provide demonstration projects that can be used by other schools (DET, 2017b). This means that these projects generate implementation reports, exemplars and even teaching and learning resources.

There is, however, little targeted provision in this funding for educational research. While the Australian Government do fund educational research in schools, the funding opportunities have been declining over the last few years and consequently any research grants for educational research have become fiercely competitive (Crossley, 2016). Further, the focus on digital technologies implementation doesn't seem to have filtered through to research funding, so projects relating to this field compete with other applied research areas. Despite this though, this is an optimal time for research into the use of digital technologies in education and researchers are always seeking ways to explore innovative practice and new ways to support learning and teaching. Some of the potential topics for research in this area are mapped in a Word Cloud displayed in Figure 4.
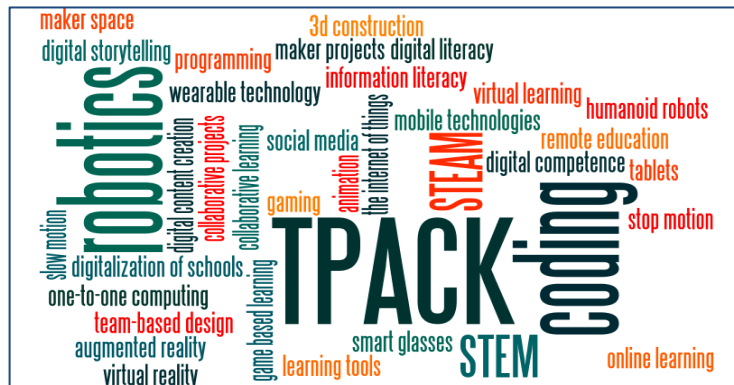

Figure 4: Potential topics for digital technologies in educational research

Examples of funded projects

While applied digital technologies research isn't especially privileged in educational research in Australia, there are a number of examples where research in to the use of digital technologies in schools have been conducted. Several recent examples are shared here.

An innovative project was the Humanoid Robotics Research Project (Keane, Chalmers, William & Boden, 2016). The research team partnered with the Association of Independent Schools of South Australia's (AISSA) Centre for Excellence & Innovation in Teaching & Learning to implement a three-year multiple case study using two NAO humanoid robots in school settings. Schools were invited to apply to 'host' the robot for a curriculum purpose of their choice. The researchers then worked with the various schools as they implemented the projects, ranging from 8 weeks to 6 months. Data was collected through teacher questionnaires, interviews and journal/video records from the educators.

One of the cases in this project was a rural school that used the robot over a six-month period to engage children with a local Indigenous language. The children at the school learnt about coding and computational thinking but also about the Narungga language through the process of teaching the robot how to speak it. This research stressed the role of curiosity to spark interest in a real-world challenge. The processes of collaboration, communication, critical thinking and creative thinking were then engaged to solve complex challenges and problems.

The King Island Digital Stories project (Masters, 2017) used digital storytelling with 21 children in a Year 4/5 class on a remote Australian island to extend their literacies and use digital technologies to communicate their sense of place. This study was funded through a Tasmanian Community Fund grant and applied an ethnographic method where two researchers worked with children in the

classroom as active participant-observers (Johnson, Avenarius & Weatherford, 2006).

The children each produced a short digital story in iMovie about their life on King Island and used a combination of still images, transitions, narration, video, green screen, animation and/or music to create their resource. These stories were published on a website and were publicly available on the Internet. The research found that the extended time given to this project enabled the children to immerse in the activity and embrace the genre for wider purposes. Further, it was evident that children's literacies had developed considerably to include aspects such as image manipulation and audio production and concepts such as copyright and cyber safety.

A third Australian example explored the implications of using digital technologies in teaching for classroom teachers (Selwyn, Nemorin & Johnson, 2017). This study was funded through an Australian Research Council (ARC) grant and used a case study approach at two Australian high schools. The researchers conducted in-depth individual interviews with 66 teachers and investigated how technologies were used for communication, administration, timetabling, assessment and reporting as well as teaching. While most teachers recognized the advantages that technologies provided, a key finding was that the use of digital technologies intensified the workload. Teachers also found that the distinction between work and personal time became blurred as the work orientated technologies became pervasive in their lives.

Discussion

The digitalization of K-12 schools in Australia is in an interesting state of flux. As described earlier in this paper, there is pressure to return to core literacies and reinforce standards in teaching and yet at the same time there is a significant push to modernize and be innovative and new. It is not a simple matter of choosing one of these directions, educators need to look at the needs of current learners, not those from the past or those in the future. It is essential that any decisions about teaching and learning is informed by careful consideration and reflective practice.

A change in student literacies has been detected by testing systems such as PISA and NAPLAN but without thorough investigation, this shift can only be observed, rather than used for judgement or a measure of the quality of education. Perhaps it simply means that the skills being tested are becoming less relevant for learners as they grapple with new ideas and circumstances? It is evident that some countries such as Singapore have improved on the PISA tests in the recent cycle but does this mean their students are better equipped for contemporary life? In the 2015 tests, the PISA added a dimension relating to student wellbeing to the test (OECD, 2017). The students in Singapore actually scored quite low on the scale for 'sense of belonging at school' and rated the highest of all surveyed countries for 'school related anxiety'. This might indicate that high achievements in traditional areas come at the expense of skills and capacities, such as resilience, that could be more important in the long term.

It is evident that Australia invested in technology for education relatively early (OECD, 2015), and they did so with the assumption that this would advantage Australian children. Critics point out that these expectations have not been met so far and there is little evidence to show that the investment in computers and other devices has led to any significant improvements. The Australian Government, however, remain committed to promoting the use of technologies in education and this is demonstrated by the current funding provided for STEM related projects (DET, 2017b). The extra funds in this area means that schools can now invest in equipment and professional development in order to implement the new Technologies Curriculum in a meaningful way.

Unfortunately, research into the use of digital technologies in education isn't particularly advantaged by this initiative. While there is a lot of exciting activity happening in schools, there is very little provision to include a research component in the projects. While it is still possible to obtain grants for this type of educational research, the cumbersome process of applying for research funding can hinder the process. The grant application process at a university is necessarily rigorous and can take several months. Then, if an application is successful, obtaining ethics will take longer, often with a number of levels of permissions and forms. Ironically, at one time, schools would have been prepared to participate in classroom based research projects in order to receive extra equipment and support to help them try out innovative ideas. However, when innovation funding is provided directly to schools it is often quicker and easier for them to go ahead and implement ideas in the classroom without the fuss of being involved in educational research.

There is no doubt that the STEM curriculum projects being implemented in Australian schools are encouraging teachers to explore the Technologies Curriculum and think about how they might teach the concepts in their own class. It is important though, that this activity is also carefully documented and reflected on in order to evaluate the merit of this activity and how learning can be enhanced and extended through the use of digital technologies. In particular, this component is essential to justify the expense and the commitment to digitalization. It is inevitable that future commentators of educational policy will look back on the strategies and practices of today and it is important that there are clear validations for the path taken.

Conclusion

While there are no crystal balls to see the future, it is obvious that digital technologies will be increasingly important in society. It is more imperative than ever that children need to be literate and informed, but this has to be in the context of the 'technology of their time' and not based on old technologies or past benchmarks. The introduction of digital technologies into the Australian Curriculum is indeed a long-awaited advancement and this means that children will now have an endorsed opportunity to learn about and with technology. The teachers of these children, however, will need significant support to implement the curriculum and this includes helping them to develop their own digital literacies and learn about 'computational thinking' in order to unpack the requirements.

The popular mandate to introduce computer coding for all learners has merit but this is only one dimension to a much larger picture. Learning to write computer code builds computational thinking but this can also be developed through a range of digital technologies projects where logic, persistence and creativity are required. Further, a digital project needs much more than code to be realized. Digital development involves a spectrum of skills and talents and more focus on collaborative partnerships and differentiated roles would enhance children's preparation for real-world skills.

In conclusion, the proliferation of digital technologies/STEM projects in Australian schools is welcomed and acknowledged as a positive initiative to support new learning. It needs to be recognized, however, that educational research aligned with these projects might add a component of reflection and rigor that is currently missing. This layer of understanding is highly desirable in order to support informed decisions about digital technologies in curriculum, teaching and education.

References

Australian Bureau of Statistics (ABS) (2017). *Statistics*. Retrieved from
http://www.abs.gov.au

Australian Council for Educational Research (ACER) (2017). *Literacy and Numeracy
Test for Initial Teacher Education Students*. Retrieved from
https://teacheredtest.acer.edu.au/

Australian Curriculum, Assessment and Reporting Authority (ACARA) (2016). *STEM
connections project*. Retrieved from
https://www.australiancurriculum.edu.au/resources/stem/stem-report/

Australian Curriculum, Assessment and Reporting Authority (ACARA) (2017a). *The
Australian Curriculum*. Retrieved from
https://www.australiancurriculum.edu.au/

Australian Curriculum, Assessment and Reporting Authority (ACARA) (2017b). *The
National Assessment Program*. Retrieved from https://www.nap.edu.au

Australian Curriculum, Assessment and Reporting Authority (ACARA) (2017c). *My
School*. Retrieved from https://www.myschool.edu.au/

Australian Institute for Teaching and School Leadership (AITSL) (2017). *Australian
Professional Standards for Teachers*. Retrieved from
https://www.aitsl.edu.au/teach/standards

Bowen, G. A. (2009). Document analysis as a qualitative research method. *Qualitative
Research Journal, 9*(2), 27-40.

Brewster, K. (2015). Experts call on computer coding to be taught to children in
schools. *Lateline*. Retrieved from http://www.abc.net.au/news/2015-08-
07/experts-call-on-computer-coding-to-be-taught-to/6682306

Chapman, S., & Vivian, R. (2017). Engaging the future of STEM. *Access, 31*(2), 48-51.

Cinque, T., & Brown, A. (2015). Educating generation next: Screen media use, digital
competencies and tertiary education. *Digital Culture and Education, 7*(1), 1-18.

Computer Science Education Research Group (CSER). *CSER Digital Technologies
MOOCs*. Retrieved from https://csermoocs.adelaide.edu.au/

Crossley, M. (2016). Infographic: How much does Australia spend on science and
research? *The Conversation*. Retrieved from
https://theconversation.com/infographic-how-much-does-australia-spend-on-
science-and-research-61094

Department of Education, Employment and Workplace Relations (DEEWR) (2009).
*Belonging, Being and Becoming: The Early Years Learning Framework for
Australia*. Canberra: Commonwealth of Australia.

Department of Education and Training (DET) (2017a). *School education*. Retrieved
from https://www.australia.gov.au/information-and-services/education-and-
training/school-education

Department of Education and Training (DET) (2017b). *Support for science,
technology, engineering and mathematics*. Retrieved from
https://www.education.gov.au/support-science-technology-engineering-and-
mathematics

Dodd, T. (2017, August 2). NAPLAN tests show little significant improvement in school
performance. Financial Review. Retrieved from
http://www.afr.com/news/policy/education/after-ten-years-naplan-tests-show-
very-little-significant-improvement-in-school-performance-20170731-gxmd56

Education Council (2015). *National STEM school education strategy*. Retrieved from http://www.educationcouncil.edu.au/EC-Reports-and-Publications.aspx

Education Services Australia (ESA) (2017). *Digital Technologies Hub*. Retrieved from https://www.digitaltechnologieshub.edu.au/

Finger, G. (2018). Digital technologies and junior secondary: Learning with and about digital technologies. In R. Jorgensen, & K. Larkin (Eds.) *STEM Education in the Junior Secondary* (pp. 197-219). Singapore: Springer.

Hatch, T. (2009). *Managing to change: How schools can survive (and sometimes thrive) in turbulent times*. New York, NY: Teachers College Press.

Hunjan, R., & Bloomer, C. (2016, December 7). Australian schools are in 'absolute decline' globally. *ABC News*. Retrieved from http://www.abc.net.au/news/2016-12-06/australian-school-performance-in-absolute-decline-globally/8098028

Johnson, J., Avenarius, C., & Weatherford, J. (2006). The active participant-observer: Applying social role analysis to participant observation. *Field Methods, 182,* 111-134.

Keane, T., Chalmers, C., Williams, M., & Boden, M. (2016). The impact of humanoid robots on students' computational thinking. In *Australian Council for Computers in Education Conference 2016, 29 September - 2 October 2016*. Brisbane, QLD.

Knobel, M., & Kalman, J. (2016). Teacher learning, digital technologies and new literacies. In M. Knobel, & J. Kalman (Eds.) *New Literacies and Teacher Learning: Professional Development and The Digital Turn* (pp. 1-20). New York: Peter Lang.

Lankshear, C., & Knobel, M. (2011). *New Literacies: Everyday Practices and Social Learning*. New York: Peter Lang.

Littlejohn, C., & Hunter, J. (2016). Messy or not: the role of education institutions in leading successful applications of digital technology in teaching and learning. *Australian Educational Leader, 38*(3), 62-65.

Masters, J. (2017). The King Island Digital Stories (KIDS) project: Telling stories for tomorrow's learning. Paper presented at the *World Conference for Computers in Education 2017 (WCCE 2017)*. Dublin, Ireland.

Organization for Economic Co-operation and Development (OECD) (2015). *Students, computers and learning: Making the connection*. PISA, OECD Publishing. Retrieved from http://dx.doi.org/10.1787/9789264239555-en

Organization for Economic Co-operation and Development (OECD) (2017). *Compare your country*. Retrieved from https://www.compareyourcountry.org/

Polesel, J., Rice, S., & Dulfer, N. (2014). The impact of high-stakes testing on curriculum and pedagogy: a teacher perspective from Australia. *Journal of Education Policy, 29*(5), 640-657.

Prinsley, R., & Johnston, E. (2015). *Transforming STEM teaching in Australian primary schools: everybody's business – Position Paper*. Canberra: Australia: Office of the Chief Scientist.

Riddle, S. (2015). The robots are coming for your job! Why digital literacy is so important for the jobs of the future. *The Conversation* (online). Retrieved from http://theconversation.com/the-robots-are-coming-for-your-job-why-digital-literacy-is-so-important-for-the-jobs-of-the-future-46730

Scott, C. (2015). The futures of learning 3: What kind of pedagogies for the 21st century? *Education Research and Foresight: Working Papers*. UNESCO. Retrieved from http://unesdoc.unesco.org/images/0024/002431/243126e.pdf

Segal, J. (2016, August 10). Australian universities are not producing enough STEM graduates. *Financial Review*. Retrieved from http://www.afr.com/opinion/australian-universities-are-not-producing-enough-stem-graduates-20160810-gqp10j

Selwyn, N., Nemorin, S., & Johnson, N. (2017). High-tech, hard work: An investigation of teachers' work in the digital age, *Learning, Media and Technology, 42*(4), 390-405.

Singhal, P. (2017, September 28). Australia's 'tolerance of failure' behind declining PISA results. *The Sydney Morning Herald*. Retrieved from http://www.smh.com.au/national/education/australias-tolerance-of-failure-behind-declining-pisa-results-says-test-coordinator-20170928-gyqlh2.html

Speranza, A. (2015). Embracing the new technologies curriculum. *Educational Technology Solutions*. Retrieved from https://www.educationtechnologysolutions.com.au/2015/06/embracing-the-new-technologies-curriculum/

Teacher Education Ministerial Advisory Group (TEMAG) (2015). *Action now: Classroom ready teachers*. Canberra, Australia: Commonwealth of Australia.

Thomson, S., De Bortoli, L., & Underwood, C. (2016). *PISA 2015: Reporting Australia's results*. Australian Council for Educational Research.