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ICT in the Australian Curriculum

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Abstract: The new Australian Curriculum aims to be suitable for the needs of 21st Century society and as such has explicitly defined a number of key roles to digital technologies. This should provide opportunities for schools and teachers to build on past reforms and prepare for the future. Over the past few years I have had various roles contributing to the development of sections of the Australian Curriculum, specifically the Technologies curriculum area, the Information and Communications Technology (ICT) general capability, and the embedding of ICT use across some of the curriculum areas. In this paper I explain my personal understanding of the place of digital technologies in the Australian Curriculum and the connection between these different roles for ICT.

Keywords: curriculum, digital literacy, computing

1. Introduction

In 1979 I started work as a new secondary school teacher at a school that was fortunate enough to have one computer terminal that could be used to dial into a mainframe computer. This terminal had to be shared among about 1000 students and therefore at the time the only impact on their curriculum was doing a few lessons on programming in BASIC. Since then I have witnessed the rapid development of digital technology, to the point now where the hardware is so inexpensive and small that many Australian schools have more computers than students, the software is so interactive and flexible that there is almost nothing we want to do with it that we can't, and systems are so connected and accessible that we can do this wherever and whenever we want. This all provides many opportunities for schools such as unlimited access to information and resources, support to implement almost any learning activity or strategy, the customisation of resources and activities, greater professionalism, and better communication. At the same time these digital technologies are becoming increasingly popular in our society with, for example, almost every teenager in Australia having a Facebook account; in 2010 that was 1,962,320 (Australian Newspaper, 5/1/2011). Should we be using these new technologies because they are popular and relatively inexpensive? NO ... BUT in making decisions about using technologies we need to respond to two basic questions.

1. Does schooling today adequately prepare children for living and working in our society tomorrow, or even today?
2. Are we happy with the learning opportunities we are providing for the range of children we have in our schools?

In essence the first question concerns the relevance of our curriculum and the second the level of engagement children of varying capabilities and motivations have with our curriculum. If the response to these is ... NO and NO ... as it is for myself, then we need to consider the options, and in particular the opportunities provided by digital technologies. In responding to the first question we are confronted with the fact that digital technologies have permeated living and working in Australian society, and as a result our children need to learn how to take advantage of the technologies, and avoid becoming subservient to them. In responding to the second question we are confronted with the fact that we have rarely been able to address the diversity of characteristics of the children in our classes and there is evidence that the 'gap' between the most and least successful students is widening (Gonski et al., 2011). As a result we need to make changes to our curriculum content and pedagogy to improve the relevance of, and student engagement with, our curriculum.

In being asked to commence writing a new national curriculum for Australia the organization that became the Australian Curriculum, Assessment and Reporting Authority (ACARA) determined to write a curriculum for the 21st Century (National Curriculum Board, 2009). For the reasons discussed earlier this meant an early focus on the place of digital technologies in the curriculum, firstly to embed use in all curriculum areas, then to develop a general ICT capability, and finally to create a Technologies curriculum area that included the study of digital technologies.

In Australia, schools and school systems, are controlled by state-based authorities. Thus curriculum has been state-based, often with substantial curriculum differences between the states. There had been earlier attempts to increase the consistency between state curricula by developing curriculum frameworks that in most states were used to guide the development of curricula. However, this time the aim was to have a single Australian curriculum to be adopted by all states and all school systems. The aim was to write the curriculum in phases starting with four curriculum areas: Mathematics; Science; English; and History. Although this has largely gained the support of educators and the public, this is not universal (Ditchburn, 2012).

Very early in the development I was afforded a small role in advising the writers of the first four curriculum areas on the inclusion of ICT. The purpose was to develop the ICT capability of students for life and work in Australian society, and to support improved learning across the curriculum. These purposes hark back to the earlier questions. However, because the curriculum was to be written as descriptions of content (National Curriculum Board, 2009) only the former purpose could really be addressed. That is, many ways that teachers would use ICT as pedagogical tools in teaching some content would not appear in the curriculum and thus couldn't be connected to the general ICT capability. Therefore to assist the curriculum writers a description of ICT capability was constructed and then presented through an age-based continuum. At the same time, similar work was being conducted to describe other general capabilities, such as literacy and numeracy.

2. ICT capability

What is ICT capability? I believe that ICT capability is a special case of technological capability (Kimbell, 2004). It is not just skills and knowledge of specific hardware and software. It is observed when ICT is used to facilitate the completion of tasks, and the solution of problems. It is the ability that we display when we are able to use knowledge, skills and dispositions towards ICT to perform relevant tasks and solve problems. We need knowledge or understandings about ICT systems, components, operations, capabilities, limitations, and use in society. We need skills in using ICT systems and we need informed attitudes toward ICT use personally, and in society. ICT capability is relative to the person, the community and the technology available. It relies on the development of transferable and useful conceptions, skills and perceptions that mature over time. As with the development of other capabilities such as literacy and numeracy, what is learned in earlier years supports later years; there needs to be a progression over time.

I joined a group of Australian educators to assist in developing a description of ICT capability and a continuum showing progression. The definition finally agreed upon was as follows.

Information and communications technology (ICT) capability refers to the capacity to use ICT appropriately and ethically to investigate, create and communicate ideas and information in order for individuals to function effectively at home, at school, at work and in their communities. (Australian Curriculum, 2012a)

We then went through a process of reviewing relevant frameworks and other curriculum documents that already existed for the Australian state education systems (e.g., Education Department of Western Australia, 1998) and various international jurisdictions. Determining the scope areas, or organising elements, as reported, referred substantially to the National Educational Technology Standards (NETS) for Students framework (International Society for Technology in Education, 2007), UK's ICT Curriculum (Department for Education and Employment, 1999), and to a lesser extent frameworks developed by other organisations (e.g., The Partnership for 21st Century Skills, 2009; WestEd, 2009). In determining stages or profiles along the continuum we had the National Assessment Program research reports from the Australian Council for Educational Research (ACER) (Ministerial Council on Education, 2007), that could be checked against the other frameworks.

The end result was a set of five organising elements with three being central to student activity and two supporting that activity. These were represented in a diagram that is shown in Figure 1. The concept was that students would develop ICT capability as they used it to investigate, create and communicate through the curriculum. In order to do this they would need to learn how to manage and operate the technology (hardware and software) and would need to do so applying appropriate social and ethical practices. Each organising element was explained using components that were described for particular stages of schooling in terms of what students should be able to do. Since that time these statements have been reviewed a number of times usually resulting in minor changes to wording but in a few cases there have been substantial changes. For example, recently an original component of the organising element *Communicating with ICT* was combined with one from *Applying social and ethical practices* and replaced with *Understanding computer-mediated communications*; this better represented sections of the English and the Arts curricula. Another example was to include the concept of generating data within the *Investigating with ICT*; this better represented sections of the Mathematics curriculum. The currently accepted nature, form and structure of the Australian ICT general capability is always presented at the website (Australian Curriculum, 2012a). Table 1 shows the current structure of the organising elements.

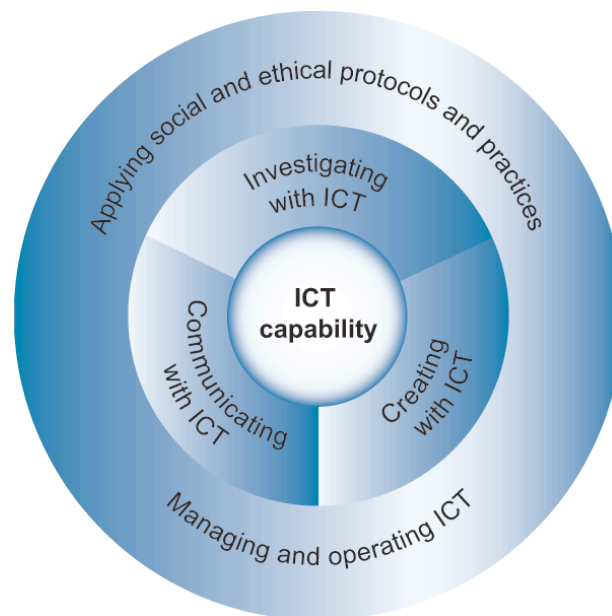


Figure 1. A graphic representation of the organising elements of the ICT capability in the Australian Curriculum (Australian Curriculum, 2012c).

Table 1: Organising elements of the ICT general capability (Australian Curriculum, 2012a).

Organising element	Components of the organising element
Applying social & ethical protocols and practices when using ICT	Recognise intellectual property Apply digital information security practices Apply personal security protocols Identify the impacts of ICT in society
Investigating with ICT	Define and plan information searches Locate, generate and access data and information Select and evaluate data and information
Creating with ICT	Generate ideas, plans and processes Generate solutions to challenges and learning area tasks
Communicating with ICT	Collaborate, share and exchange Understand computer mediated communications
Managing and operating ICT	Select and use hardware and software Understand ICT systems Manage digital data

I initially envisaged that much of the activity of students across the curriculum would involve the *Creating with ICT* element of the capability, in particular generating products as solutions to problems (“Generate solutions to challenges and learning area tasks”). I recognised that these solutions would include different digital types and initially a list of potential types were explained to help curriculum writers to consider a broad range of digital solutions. At the time I listed some types of digital solutions: Publishing and Presentation; Word Processing; Graphics and Animation; Audio/Music; Video; Data Processing; Control/Programming; and Computation and Modelling. Profiles that describe demonstration of capability at Years F, 2, 4, 6, 8 and 10 are presented as a sequence of the continuum on the website with examples and links (Australian Curriculum, 2012b). Although the capability is presented in small chunks associated with components of the organising elements it is still intended that teachers develop the capability systematically and in context of the curriculum areas. I believe that the focus should always be on conceptual development rather than one-off activities (e.g. an understanding of the structure of ICT systems & functions of components).

3. Embedded in all curriculum areas

It was clearly always the intention to embed the requirements of the ICT general capability within all areas of the curriculum (National Curriculum Board, 2009). However, I believe that the over-riding consideration in using ICT to support the requirements of a learning area should be to solve educational problems, not to build ICT capability. Appropriate use of ICT will not always contribute significantly to ICT capability. For example, if senior secondary students use *Yenka* science modelling software it is unlikely that clicking and dragging on objects will advance their ICT capability, despite the value to science outcomes in using the software. Conversely when children in the early years of schooling use software such as *Millie’s MathsHouse* this is likely to not only contribute to mathematical understanding but also add to their ICT capability.

The ICT general capability continuum assisted in matching the expected capabilities of students with the requirements for the applications of ICT being used. The Australian curriculum areas have the ICT ‘hooks’ that school systems leaders and teachers can use to contribute to a systematic and comprehensive development of ICT capability. The Australian Curriculum website (Australian Curriculum, 2013a) helps by providing the ICT capability as a filter within each of the curriculum areas and then links to the components of the capability, and to supporting resources through an online repository accessed through a tool known as *Scootle* (Education Services Australia, 2013). Although the capability is now embedded in the Australian curriculum and should contribute to student ICT capability this will necessarily be patchy and inconsistent. Therefore, in the same way that language literacy is overseen by the English curriculum area, and numeracy by Mathematics, I believed that a curriculum area was needed that would ensure a comprehensive ICT capability.

4. Technologies curriculum area

Finally a Technologies curriculum area was conceived with two distinct subjects: Design and Technology; and Digital Technologies. The former focusing on technologies associated with materials such as food, wood and metal; and the latter focusing on computer-related technologies. When the full draft was prepared for consultation (Australian Curriculum, 2013b) each subject was organised into two strands, defined differently for each subject: *Knowledge and Understanding*; *Processes and Production*. The content of the subjects was described for Foundation (age 5) to Year 10 (age 16) in two-year phases of schooling with the focus of the strands changing from phase to phase. Although the content was described separately for each subject it was not intended that they should necessarily be taught separately. In fact teachers were encouraged to integrate implementation wherever possible between the subjects, and across other curriculum areas.

The curriculum area had a number of key overarching ideas: systems thinking; creating preferred futures; and project management. Naturally it had strong links with the ICT general capability, explained as, “While much of the explicit teaching of ICT occurs in the Digital Technologies subject, key ICT concepts and skills are strengthened, complemented and extended in Design and Technologies as students engage in a range of learning activities with ICT demands” (Australian Curriculum, 2013b). The *Knowledge and Understanding* strand of Digital Technologies

included: how data are represented and structured symbolically; the components of digital systems (software, hardware and networks) (Years 5 to 10 only); and the use, development and impact of information systems in people's lives (Australian Curriculum, 2013b). This strand focused on developing the underpinning knowledge and understanding of information systems: data, processes, digital systems, people, and their interactions. It also included understanding of the impact of digital technologies in people's lives. The *Processes and Production* strand of Digital Technologies was very much informed by the theory of Computational Thinking (Wing, 2006). The components of the strand were: collecting, managing and interpreting data when creating information, and the nature and properties of data; using a range of digital systems and their components and peripherals; defining problems and specifying and implementing their solutions; creating and communicating information, especially online (Australian Curriculum, 2013b). This strand focused primarily on defining and solving problems through using digital systems, critical and creative thinking and applying computational thinking – a problem-solving methodology. Students were to develop and use increasingly sophisticated computational thinking skills, and processes, techniques and digital systems to create solutions to address specific problems, opportunities or needs. It was also suggested that students would apply procedural techniques and processing skills when investigating, creating, communicating and sharing ideas and information and collaborating in online environments.

Key concepts for the Digital Technologies subject are related to the construct of computational thinking (Computer Science Teachers Association (CSTA) and the International Society for Technology in Education (ISTE), 2011). Fundamentally this is a problem-solving methodology that begins with formulating problems, logically organising and analysing data, and representing it in abstract forms such as data tables, digital graphs, spreadsheets, models and animations. The end result should be automated solutions through algorithmic and declarative logic, and determining the best combinations of data, procedures, and human and physical resources to generate efficient and effective information solutions. Key concepts of abstraction, data collection, specification, digital systems, and interactions permeate the content of the proposed curriculum (Australian Curriculum, 2013b). It is stated that the concept of abstraction overarches much of the content particularly relating to the concepts of data representation and specification, algorithms and implementation. Data collection (properties, sources and collection of data), data representation (symbolism and separation) and data interpretation (patterns and contexts) contributes to the design of solutions. Solutions require specification (descriptions and techniques), algorithms (following and describing) and implementation (translating and programming). Digital systems involving hardware, software and networks provide interactions between people and between digital systems, data and processes.

An example of the form of the curriculum is elaborated from the F-2 section of the document (Australian Curriculum, 2013b).

2.4 Identify, explore, and use digital systems (hardware and software components) for personal and classroom needs by ...

2.5 Follow, describe, represent and play with a sequence of steps and decisions needed to solve simple problems by ...

A teacher interpreting these to construct a program of lessons for a class may think of using robotics, digital microscopes, or even a visual programming environment, as contexts for students to learn. The curriculum also provides achievement standards associated with content descriptions. At this stage the Technologies curriculum is under review and therefore nothing is certain and I believe that it is likely that individual state authorities and schools will determine how it is implemented.

5. Conclusion

From the first uses of ICT in schools in the 1970s the connection between the curriculum and the technologies has become progressively more complex. I believe that digital technologies have complex, varied and complementary roles within the Australian curriculum as it now stands. Firstly, they provide *Pedagogical Tools* in all areas of the curriculum, including the Technologies area (e.g. accessing information, simulations, supporting communication and collaboration). Secondly, they are related to particular *Content* within many areas of the curriculum (e.g. calculators in Maths computation and modelling, GPS in Geography, technological change in History, digital art, digital video analysis for coaching in HPE, device control in Science). Thirdly, they provide *Technical Tools* to support the design process in the Technologies area. Finally, they provide the *Subject* for study in

the Digital Technologies subject in the Technologies curriculum area. That is, the production of a digital solution is an end in itself. Over the next few years I hope that these pieces of the curriculum jigsaw fit into place to better prepare our children for living and working in our 21st Century society.

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