

## **Creativity, Visualisation, Collaboration and Communication**

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## CHAPTER 8

# Creativity, visualisation, collaboration and communication

*Glenn Finger*

### Introduction

The central question of this book is: What critical issues do teachers need to know in order to help them make better decisions in the classroom? Specifically, in helping develop answers to this question, this chapter focuses on creativity, visualisation, collaboration and communication and will encourage readers to understand the opportunities they present. While this chapter also refers to the Australian curriculum, readers are encouraged to transfer the key messages to their own contextual settings, wherever they might be preparing to become teachers or are already practising teachers. This is important to understand because curriculum differences are likely. Therefore, the examples used in this chapter are not prescribed examples, but used for illustrative purposes to glean deeper understandings in response to the chapter's intent.

The key knowledge and skills in using digital technologies are now often integral to contemporary educational policies and curriculum, such as in the Australian curriculum. To illustrate, the Australian curriculum's technologies learning area 'encourages students to apply their knowledge and practical skills and processes when using technologies and other resources to create innovative solutions, independently and collaboratively, that meet current and future needs' (ACARA, 2014a, p. 1). In addition, information and communication technology (ICT) capabilities is one of the general capabilities of the Australian curriculum, which 'encompass the knowledge, skills, behaviours and dispositions that, together with curriculum content in each learning area and the cross-curriculum priorities, will assist students to live and work successfully in the twenty-first century' (ACARA, 2013, p. 1).

Importantly, digital technologies, which have become increasingly pervasive, present exciting challenges and opportunities for teaching and learning to promote creativity, and to enable visualisation, collaboration and communication. It is important that pre-service and practising teachers are able to design and implement meaningful learning experiences for their students so they can successfully develop and demonstrate these capabilities.

This necessitates an understanding that the development of Technological Pedagogical Content Knowledge (TPACK) (see Mishra & Koehler, 2006; 2008) capabilities is required, so that digital technologies can be used to support teaching and learning to develop these skills within and across learning areas. In this way, capabilities are developed which enable technological knowledge, pedagogical knowledge and content knowledge to be drawn upon to enable young people to become 'successful learners, confident and creative individuals, and active and informed citizens' (MCEETYA, 2008, p. 7).

## CRITICAL QUESTIONS

- Why are creativity, visualisation, collaboration and communication important for learning and teaching?
- How might digital technologies create opportunities for learners to develop and demonstrate creativity, visualisation, collaboration and communication within and across learning areas?
- What TPACK capabilities do pre-service and practising teachers need so that they can create those opportunities for their students to develop and demonstrate creativity, visualisation, collaboration and communication?

Underpinning the construction of this chapter is an understanding that learning the profession of teaching can be seen as a wonderful 'process of becoming' (Carr, 2013, p. 31). Thus, this chapter provides an alternative approach to the more conventional explanations of professional practice, which attempt to codify teacher quality. Rather, it adopts a social and participative approach by seeing practice using digital technologies as situated in complex contexts, and understanding practice as performance, practice as judgement amidst 'hot action' (Eraut, 1994, p. 53), practice as explicit and tacit, and practice as reproducible and transformative (Carr, 2013).

This approach is deliberate in assisting critically important understandings that teaching with digital technologies is complex and needs to be understood in relation to diverse and challenging contexts. This aligns with Mishra and Koehler (2006) drawing upon Rittel and Weber's (1973) reference to 'wicked problems' being incomplete, contradictory, changing and occurring in complex and unique social contexts. It differs from the reductive approach often evident in much of the political and media commentary about teacher quality. Rather, in considering creativity, visualisation, collaboration and communication and the role of digital technologies in relation to these, practices are seen as situated in complex contexts.

Importantly, 'learning to become a professional involves not only what we know and can do, but also who we are becoming' (Dall'Alba, 2009, p. 34). This opens up conversations and thinking about the TPACK capabilities of teachers to be able to identify, design, implement, analyse, manage, and critically reflect upon changes in curriculum, pedagogy, assessment and technologies throughout the ongoing process of becoming a professional.

## Creativity, visualisation, collaboration and communication and digital technologies

In the following sections, creativity, visualisation, collaboration and communication are shown to be important for learning and teaching. Furthermore, they provide discussion suggesting how digital technologies can create opportunities for learners to develop and demonstrate creativity, visualisation, collaboration and communication within and across learning areas.

While the following sections are organised in terms of creativity, visualisation, collaboration and communication and digital technologies, it is important to understand their considerable interactions and inter-relationships. For example, creativity can involve visualisation of solutions that are developed through collaborative problem-solving approaches. 'Communication is integral to each of the thinking processes. By sharing thinking, visualisation and innovation, and by giving and receiving effective feedback, students learn to value the diversity of learning and communication styles' (ACARA, 2013, p. 79).

### Creativity and digital technologies

For the purpose of this discussion, Sir Ken Robinson's definition is presented whereby creativity is defined as 'the process of having original ideas that have value' (Robinson, 2013, p. 1). For Robinson, creativity is applied imagination. In his various writings and presentations, he often provides stories of creative and successful people, who needed a teacher to nurture their passion. For example, he conveys the story of Hans Zimmer, the German film composer who loved to play the piano, but disliked learning scales through rote learning. Robinson tells the story that when Zimmer tried to play or compose, he would be told to practise his scales. According to Robinson, Zimmer was disruptive at school and admits to being thrown out of eight classes, until he joined the ninth class. Zimmer told the headmaster that all he really wanted to do was to play music. With the headmaster's support, he spent most of his time doing that. Robinson explains:

Slowly he became engaged in other work too ... Suddenly all this stuff started to come alive. Learning wasn't about learning things by heart and then regurgitating them like a bad cheese sandwich. He was fantastic. (Robinson, 2013)

This is a remarkable example, as Zimmer went on to compose music for more than 150 films, including *The Lion King*, *Gladiator*, *The Dark Knight*, and, more recently, *12 Years a Slave*. Zimmer's work is moving, inspirational, brilliant and creative. He is known for his integration of traditional orchestral arrangements with electronic (digital) sounds! Thus, says Robinson, the role of the teacher requires connoisseurship and creativity on the part of the teachers themselves, and 'for creativity to flourish, schools have to feel free to innovate without the constant fear of being penalised for not keeping with the programme. Too much prescription is a dead hand on the creative pulse of teachers and students alike' (Robinson, 2013, p. 1). How closely does this resonate with your role as a teacher if Hans Zimmer had been one of your students?

How does creativity find expression in the Australian curriculum? Critical and creative thinking are identified as important general capabilities which students need to develop 'to generate and evaluate knowledge, clarify concepts and ideas, seek possibilities, consider alternatives and solve problems' (ACARA, 2013, p. 78). Thus, in designing learning experiences, critical and creative thinking are seen as being integral to those experiences through requiring students to use 'skills, behaviours and dispositions such as reason, logic, resourcefulness, imagination and innovation in all learning areas at school and in their lives beyond school' (ACARA, 2013, p. 78). ACARA (2013) provides a very useful synthesis of research in identifying creative thinking as:

- dispositions (Tishman, Perkins & Jay, 1995; Ritchhart, Church & Morrison, 2011);
- taxonomies of skills (Anderson et al., 2001);
- habits and frames of mind (Costa & Kallick, 2004; Gardner, 2009; de Bono, 2009);
- thinking strategies (Marzano, Pickering & Pollock, 2001); and
- philosophical inquiry (Lipman, Sharp & Oscanyan, 1980).

As we proceed in the 21st century, students will require the development of the dispositions, skills, thinking strategies and philosophical inquiry for futures that might only be imagined. When considering digital technologies, these can frame and inform the design of learning experiences which promote students to engage in inquiry, the generation of ideas, possibilities and actions, reflection on their thinking, and analysis, synthesis and evaluation of reasoning and procedures. As we know little about the kinds of futures which today's students might face throughout the rest of the 21st century, imagining possibilities and considering alternatives is critically important.

In using digital technologies to develop creative thinking, remember Robinson's definition, which emphasises that creativity is dynamic; it makes new connections, and crosses disciplines. The Australian curriculum provides guidance on developing critical and creative thinking skills across the curriculum (ACARA, 2014b). There is an excellent filter function in the Australian curriculum that enables the selection of a learning area/s, year level/s, strands, general capabilities, and cross-curriculum priorities. For example, a teacher can filter for English, Year 5, the strand of language,

**Table 8.1:** An example of information and communication technology and critical and creative thinking capabilities: Year 5 English Language Text structure and organisation

English / Year / 5 / Language / Text structure and organisation	
Content Description	
Investigate how the organisation of texts into chapters, headings, sub-headings, home pages and sub-pages for online texts and according to chronology or topic can be used to predict content and assist navigation	
Information and communication technology capability	
The particular elements of Information and technology capability addressed by this content description	
Investigating with ICT	Managing and operating ICT
<ul style="list-style-type: none"> <li>• Locate, generate and access data and information</li> </ul>	<ul style="list-style-type: none"> <li>• Select and use hardware and software</li> </ul>
<ul style="list-style-type: none"> <li>• Select and evaluate data and information</li> </ul>	Creating with ICT
	<ul style="list-style-type: none"> <li>• Generate solutions to challenges and learning area tasks</li> </ul>
Critical and creative thinking	
The particular elements of Critical and creative thinking addressed by this content description	
Inquiring – identifying, exploring and organising information and ideas	Reflecting on thinking and processes
<ul style="list-style-type: none"> <li>• Identify and clarify information and ideas</li> <li>• Organise and process information</li> </ul>	<ul style="list-style-type: none"> <li>• Reflect on processes</li> </ul>

the Information and Communication Technology and the Critical and Creative Thinking general capabilities to obtain planning advice, and produce results such as that shown in Table 8.1.

The following section continues this conversation on creativity by examining visualisations.

## Visualisation and digital technologies

This discussion on visualisation commences with the provocative statement that anything that can be imagined can be visualised with digital technologies. To develop an understanding of what visualisation and digital technologies might relate to, the Victorian Curriculum and Assessment Authority (VCAA), which incorporates the Australian curriculum, provides the Victorian Essential Learning Standards (AusVELS) (see <<http://ausvels.vcaa.vic.edu.au/>>). Directly relevant to this chapter is the interdisciplinary Information and Communications Technology domain, which is organised according to Learning Focus, Standards, and Dimensions (see VCAA, 2014). The dimensions include ICT for visualising thinking in which:

ICT tools that facilitate visual thinking are ones that allow ideas and information in all areas of the curriculum to be easily and quickly drafted, filtered, reorganised, refined and systematically assessed in order to make meaning for students. Students use linguistic and non-linguistic representations, such as graphic organisers, ICT-generated simulations and models and ICT-controlled models to help structure their thinking processes and assist in constructing knowledge. (VCAA, 2014, p. 1)

Similarly, a search of the F-10 Australian Curriculum, using 'visualisation', returned 30 examples where students engage in visualisation, not only in the digital technologies learning area, but across all areas and relating to general capabilities such as critical and creative thinking discussed in the previous section. For example, as shown in Table 8.2, in the Year 5 Digital Technologies Processes and Production Skills, the Content Description requires students to '... use a range of commonly available software to interpret and visualise data in context to create information'. The elaborations provide more comprehensive explanations of these expectations for students to demonstrate. In relation to using visualisation in other learning areas, there is a vignette of a Year 9 teacher developing reading comprehension skills through visualisation (Education Services Australia, 2014a). Interestingly, the students are asked to choose their own form for visualising the text, and this results in a rich range of visualisations.

What are the various ways in which students can visualise data, information, ideas, problems and solutions, and relationships? *The Data Visualisation Catalogue* (see <<http://www.datavizcatalogue.com/>>) provides functions and tools for designing and generating visualisations. As well as various graphs, histograms, and charts, there are some interesting visualisations to consider, such as population pyramids, timelines, sankey diagrams, tally charts, word clouds, tree maps, chord diagrams, heat maps and sunburst diagrams. Other online tools are available such as *Webspiration*, which provides examples of how it can be used for visualisations for English, science, and history (see <<http://www.webspirationpro.com/examples>>).

## Collaboration and communication and digital technologies

Directly relevant to examining collaboration and communication and digital technologies is Communicating with ICT, which is an organising element within the Australian curriculum's Information and Communication Technology capability (ACARA, 2014c). This element involves students in 'using ICT to communicate and share ideas and information to collaboratively construct knowledge and digital solutions'. There is a close connection with the previous sections on digital technologies, creativity, and visualisation. Moreover, it relates to the introductory commentary, which requires understandings of the complexity of contexts, because communicating with ICT requires students to understand context, sense of audience, forms of communication, techniques, and the technologies themselves.

This capability outlines that students collaborate, share and exchange and understand computer-mediated communications. A learning continuum for Levels 1 to 6 is provided for Communicating with ICT. For example, Level 5 indicates

**Table 8.2:** Visualisation: An example in content description and elaborations in the digital technologies learning area in the Australian curriculum – Years 5 and 6

ACTDIP016 / Content Description / Years 5 and 6 / Digital Technologies / Digital Technologies Processes and Production Skills	
Content Description	Elaborations
Acquire, store and validate different types of data and use a range of commonly available software to interpret and visualise data in context to create information	<ul style="list-style-type: none"> <li>• using digital systems to validate data, for example setting data types in a spreadsheet to make sure a date is input correctly</li> <li>• selecting and using peripheral devices suitable to the data, for example using a data probe to collect data about changing soil temperatures for plants, interpreting the data and sharing the results as a digital graph</li> <li>• recognising the difference between numerical, text and date formats in spreadsheets</li> <li>• using software to automate calculations to help with interpreting data, for example using functions to make arithmetic calculations using multiple cells and summing cell ranges</li> <li>• acquiring data from online sources by narrowing the focus, for example filtering data using provided options or performing queries using advanced search functions</li> <li>• using data visualisation software to help in interpreting trends, for example uploading data to a web application and building a visualisation of the dataset</li> </ul>

that typically by the end of Year 8, students ‘Collaborate, share and exchange’, and ‘Select and use appropriate ICT tools safely to lead groups in sharing and exchanging information, and taking part in online projects or active collaborations with appropriate global audiences’ (ACARA, 2014d). An example could be setting up a wiki or blog to engage and interact with others, and, as shown in Table 8.3, relates specifically to English, science and history Content Descriptions and Elaborations.

Useful digital resources, including learning objects, images, audios, videos, collections, teacher resources, assessment resources and datasets are available at Scootle (Education Services Australia, 2014b; see <<http://www.scootle.edu.au/ec/p/home>>). A search can be conducted using a filter of the learning area, year level, and the resource type. Scootle is very highly recommended for both students and teachers, and, in particular, the Scootle community provides a professional learning



**Table 8.3:** Curriculum examples of the organising element **Communicating with ICT** in English, science and history

English / Year 7 / Language / Language variation and change/ Content description
Understand the way language evolves to reflect a changing world, particularly in response to the use of new technology for presenting texts and communicating
Elaborations <ul style="list-style-type: none"> <li>• exploring languages and dialects through building webcam relationships with schools across Australia and Asia</li> <li>• investigating changes in word use and meaning over time and some of the reasons for these changes, for example the influence on spelling and vocabulary of new forms of communication like texting, emoticons and email</li> </ul>
Science / Year 7 / Science Inquiry Skills / Communicating / Content description
Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate
Elaborations <ul style="list-style-type: none"> <li>• presenting the outcomes of research using effective forms of representation of data or ideas and scientific language that is appropriate for the target audience</li> <li>• using digital technologies to access information and to communicate and collaborate with others on and off site</li> </ul>
Humanities and Social Sciences / History / Year 8 / Historical Skills / Explanation and communication / Content Description
Use a range of communication forms (oral, graphic, written) and digital technologies
Elaborations <ul style="list-style-type: none"> <li>• creating an oral presentation, supported by audio-visual material, to recount the life of Temujin (Genghis Khan) and to explain his contribution to the Mongol world</li> </ul>

network for all Australian educators to ‘Learn, teach and collaborate using digital resources to support the Australian Curriculum’ (Education Services Australia, 2014b, Homepage). For collaborating and communicating opportunities using Scootle, examine the *10 Ways you can use Scootle* (Education Services Australia, 2014c), which include:

- 1) **Register** to gain access to many thousands of digital resources;
- 2) **Belong** and share in a professional learning network;
- 3) **Connect** and join networks that you are passionate about or create your own;
- 4) **Reflect** and share your reflections and ideas through blogs;
- 5) **Browse** using search functions and apply filters for identifying resources for the Australian Curriculum;
- 6) **Curate** through creating, annotating and sequencing stimulating personalised learning paths for students;
- 7) **Scan** ‘Direct from Publishers’ to explore other solutions;
- 8) **Personalise** using the quiz builder to create your own questions for your students;

- 9) **Collaborate** and flip the classroom through creating secure collaborative workspaces through learning paths; and
- 10) **Share** learning paths with students, peers, and educators. (Education Services Australia, 2014c)

For students, and teachers, there are exciting collaboration and communication opportunities that can enhance teaching and learning. However, previous models which reflected a hierarchical, command and control approach in students accessing information and communicating have been disturbed through, for example, social media which might be categorised into six types (Grahl, 2014); namely, Social Networks (for example, Facebook, LinkedIn), Book marking sites (for example, Delicious, StumbleUpon), Social News (for example, Digg, Reddit); Media Sharing (for example, YouTube, Flickr), Microblogging (for example, Twitter), and Blogs and Forums (for example, *Scout24 Community*).

As students can collaborate and communicate using social media almost anywhere and anytime, without parental or teacher supervision, there is a need for teachers and students to understand digital citizenship (Ribble, 2014a) for using technologies appropriately and responsibly. The nine elements of digital citizenship – digital access, digital commerce, digital communication, digital literacy, digital etiquette, digital law, digital rights and responsibilities, digital health and wellness, and digital security – need to be better understood and embedded in student use of digital technologies when collaborating and communicating. The research conducted for the *Teaching Teachers for the Future Project*, involving 39 higher education institutions which provide initial teacher education programs in Australia, found that initial teacher education students were least likely to be confident in using ICT to support teaching digital citizenship to promote student demonstration of rights and responsibilities in the use of digital resources and tools, and in managing challenging student behaviour by encouraging responsible use of ICT (Finger et al., 2013). Thus, teachers and students need to recognise the importance of this challenge by building digital citizenship understandings, confidence and capabilities as they increasingly engage in collaboration and communication using digital technologies.

## TPACK capabilities

What TPACK capabilities do pre-service and practising teachers need so that they can create those opportunities for their students to develop and demonstrate creativity, visualisation, collaboration and communication?

The expectations for teachers in using digital technologies for teaching and to support student learning are now substantially different from those expectations for someone preparing to be a teacher decades earlier. Forty years ago, for example, a teacher required skills in using a blackboard, an overhead projector and a cassette player. Throughout your career you can expect further dynamic technological changes. As outlined earlier in this chapter, teachers are encouraged to develop

TPACK capabilities that enable new technologies to be used and repurposed to support teaching and student learning.

In his influential article *Knowledge and Teaching: Foundations of the New Reform*, Shulman (1987) noted that rich portrayals of pedagogical excellence are rare. In understanding models of pedagogical excellence, it is useful to draw upon Shulman (1986; 1987), who made a substantial contribution to our exploration of the knowledge base for teaching, through proposing pedagogical content knowledge (PCK), and an accompanying model of pedagogical reasoning and action.

That model of pedagogical reasoning and action commences with the *comprehension* of the purpose, the subject matter structures, and ideas within and outside the discipline, and then progresses to *transformation*, which includes preparation, presentation, selection, and adaptation and tailoring to student characteristics. Effective teachers engage deeply with these phases, before proceeding to the next phase of *instruction*, which Shulman suggests might include strategies such as interactions, presentations, humour, questioning, active teaching or inquiry instruction. Subsequently, *evaluation* is undertaken to check for student understanding as well as evaluating your own performance. The following phase of *reflection* is important to enable reviewing, reconstructing, re-enacting and critically reflecting on the teaching and learning that has occurred. According to Shulman, this leads to *new comprehensions* of purposes, subject matter, students, teaching and self.

To summarise, Shulman's model of pedagogical reasoning and action involves comprehension, transformation, instruction, evaluation, reflection and new comprehensions, and this has informed the design of most initial teacher education programs. However, this model was proposed well before the significant technological changes we have witnessed since 1987. Arguably, few could have imagined the technological innovations that have occurred since that time and nobody can confidently predict the future technological changes that might occur.

Subsequently, Mishra and Koehler (2006) proposed the TPACK conceptualisation to include technological knowledge, as well as content knowledge and pedagogical knowledge. Teachers are becoming familiar with the TPACK conceptualisation and can engage more deeply through the expanding TPACK literature and research. Some writers (Smart et al., 2013a; Smart, Sim & Finger, 2012; 2013b; Finger & Finger, 2013) have suggested that it follows logically that Mishra and Koehler's TPACK conceptualisation which built upon Shulman's PCK, needs to be complemented by a model of technological pedagogical reasoning and action. They argue that, in a significantly more advanced technological world in which teaching and learning takes place, teachers engage in pedagogical reasoning with technologies.

Consequently, as learning experiences using digital technologies are designed and implemented to develop creativity, use visualisations, and enable collaboration and communication, consider how future and practising teachers need to expand the model of pedagogical reasoning and action to use technological pedagogical reasoning and action. Niess et al. (2009), for example, in discussing mathematics teachers and TPACK, effectively argue that teachers, who employ pedagogical

content knowledge, move through phases of recognising, accepting, adapting, exploring and advancing the use of technological knowledge to reflect TPACK. In the process of becoming a professional, by drawing upon pedagogical knowledge, content knowledge and technological knowledge, teachers can promote creativity, utilise visualisation, and enable collaboration and communication in ways that digital technologies are used to reflect Shulman's phases of comprehension, transformation, instruction, evaluation, reflection, and new comprehension within and across learning areas.

It is important that teachers adopt approaches to professional learning, (for example, through professional learning networks) which promote their own creativity, collaboration and communication, to build TPACK confidence and capabilities.

## Concluding comments

This chapter outlined the importance of creativity, visualisation, collaboration and communication in learning and teaching, and how digital technologies might create opportunities for learners to develop and demonstrate these within and across learning areas. To conclude, the TPACK conceptualisation was discussed so that the interface between technological knowledge, pedagogical knowledge and content knowledge could be drawn upon in ways that engage teachers in technological pedagogical reasoning and action to develop new comprehension for students. The key messages and issues developed were:

- Creativity, visualisation, collaboration and communication are important capabilities for students to develop and demonstrate.
- Through specific reference to examples from the Australian curriculum, creativity, visualisation, collaboration and communication were discussed in terms of learning areas and general capabilities; for example, *Australian Curriculum: Technologies* learning areas and the *Critical and Creative Thinking* and *Information and Communication Technology* general capabilities.
- There are digital technologies to support the Australian curriculum which can promote opportunities for creativity, visualisation, collaboration and communication; for example, through *Scoutle* and social media, and there is an accompanying need to develop digital citizenship.
- Learning the profession of teaching can be seen as a wonderful 'process of becoming' (Carr, 2013, p. 31) and, as digital technologies and teaching is a 'wicked problem', the development of TPACK capabilities and the ability to engage in a process of technological pedagogical reasoning and action is encouraged. Teachers themselves require opportunities for creativity, and collaboration and communication; for example, through professional learning networks.

## Exploring

- Undertake an Internet search to locate and view Sir Ken Robinson's provocative TED talk called *How schools kill creativity*. Critically reflect on his argument and what he suggests teachers and schools might do to nurture creativity. Are there aspects of his presentation that affirm or challenge your thinking, which you have developed after reading this chapter?
- From your understanding of TPACK and professional standards for teachers, outline your thoughts on how you use digital technologies and pedagogical approaches to develop creativity and enable collaboration and communication within and across the learning areas in which you teach.
- Consider how visualisation is used in the real world, such as in industry, government, banking, retail, media, and health professions. What visualisations have you explicitly used in teaching and learning? What visualisations might you explore to enhance your teaching and support student learning?



Further information and resources on this topic are available at <[www.cambridge.edu.au/academic/](http://www.cambridge.edu.au/academic/)>

## Further reading

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