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Foreword

Whether we like it or not, we live in a digital environment and work in a digital workplace. We rely on digital tools like our smartphones and Google to find our way through the day and would be lost, literally and figuratively, without them. The vast majority of us probably find that the benefits of these digital tools outweigh the problems, though this doesn't mean that we're not anxious about the digital future we find ourselves living in. France, for example, banned mobile phones in the classroom in 2018, while locally Victoria did the same just this year with considerable public support. While these concerns spread, at the same time, it's widely considered that digital skills – and digital literacy and coding in particular – will be essential for these students in the future. The latest issue of Deloitte's *Building the Lucky Country* series of reports, *The path to prosperity: Why the future of work is human*,¹ highlights a perceived gap between demand from business for these digital skills, and the actual skills that job-seekers hold – a gap that appears to be growing. We could ask ourselves: are we using digital technology too much, or not enough?

It was for this reason that I was glad when Deloitte Centre for the Edge and Geelong Grammar School decided to collaborate on hosting a national series of roundtables to better understand the call *to teach everyone how to code*, and unpack what this phrase really means. What started as a series of roundtables developed into a project, as the collaboration explored one question only to find another, and then another. Questions concerning a lack of skill evolved into questions of a lack of agency: the ability for a graduate, or even experienced worker, to navigate and be effective in a society and workplace shaped by digital technology.

Two important insights emerged from this project. First, that knowing *why* and *when* to use digital technology is possibly more important than knowing how to use it. Second, that *knowing of* something, rather than *knowing it* (remembering it by heart), is often sufficient as we can always reach out, via the magic of the internet, and learn on demand. The implication for business is that what our staff might be lacking is not skills, but discernment; the ability to understand when and why it is appropriate to use a digital tool, and an understanding of how the digital tool will affect their work (both for better and worse). The challenge for educators is to instil this discernment in students, to help them understand the *when* and *why* of digital tools, and to realise when something they *know of* would be worthwhile *knowing*.

This project contains a wealth of ideas and frameworks for thinking about and discussing the challenge of adapting to the digital world we find ourselves in, both as individuals and as organisations. What it doesn't provide are prescriptive solutions that attempt to revolutionise the education system. As it turns out, our education system isn't broken, though there are significant challenges. Nor do we need to develop yet another digital curriculum. The shift we need to make is more concerned with how we enact the existing curriculum, to focus on *when* and *why*, and not just *how*, and accepting that *knowing of* is often as good as *knowing* itself.

Colette Rogers

Partner
National Leader, Education
Deloitte

Foreword

Just like any interaction, we believe...

The digital revolution continues to have a profound impact on societies around the globe. The relationship between people and knowledge has changed. Data is ubiquitous, with facts, news and entertainment available at the click of a button. The associated immediacy and expansive reach of digital technologies have stimulated an energising evolution in education. Teachers and libraries are no longer the sole repositories of information. Students, and indeed all of us as citizen learners, now have a transformational alliance with technology. Just like any interaction, this relationship requires careful consideration.

As with many significant changes in human history, the digital revolution has occurred at lightning speed: forty years ago, no-one had a digital device with them twenty-four hours a day, and computers were largely novelties used by scientists. The first laptop was released in 1979,² the first mobile phone call was made in 1973³ and the first SMS was sent in 1992.⁴ With hallmarks of accessibility and convenience, devices initially represented hopeful prospects for learning and teaching, as well as human connection. Today, there is an emerging global trend towards banning mobile phones during school hours, and computers are often seen as sources of gaming addiction. With such perceptions and choices, it would seem that the digital revolution has not represented an egalitarian silver bullet for the nation's education system.

How then can education respond? This second stage of collaboration between Geelong Grammar School and Deloitte

Centre for the Edge has been investigating the challenges of a digital world. Another wide range of stakeholders gathered around Australia to discuss the realities of this world, from cradle to grave. Personal stories gave voice to experiences in the new digital age, where the penalties of illiteracy are severe, and where the gatekeepers of information hold unparalleled power.

Many recent discussions centred around the "skills gap", with prescriptive solutions offered to aid us to navigate a flexible lifestyle of personal pursuits and work. This time our roundtables also gave rise to participants finding resonance with digital devices being defined as tools not only requiring manual skills, but discernment. Here lies yet another challenge for education. How might we best equip students to develop discernment when interacting digitally?

Just like any interaction, principles and standards of behaviour guide choices for individuals, communities and sectors. We continue to argue that our Australian education system is not broken, and does not require a revolutionary change, such as all classes being delivered online. Rather, we support incremental changes, optimising the existing curriculum, and continuing to shift our focus from memorisation and regurgitation of information, to more reflective exchanges congruent with our divergent world: we have a responsibility to educate discerning students, whose multiplicity of divergent skills (for a divergent world) interface deftly with digital technologies; such deftness overlays an individual's capacity to make values-based decisions.

In evaluating circumstances and contemplating alternatives, decision-makers rely on attitudes and behaviours. We believe that attitudes can be cultivated, but they are not enough. Judgment sits between attitudes and behaviours. Exercising judgement is a competency demanding critical thinking, collaboration, problem solving and, more importantly, problem posing. Such terms comprise the new lexicon of an educational philosophy which offers students an informed future. This philosophy prioritises teachers as expert guides and adaptive facilitators, not merely content delivery agents for standardised tests.

At Geelong Grammar School, our educational philosophy and evolution motivates fresh perspectives. Through the lenses of Creative Education, Positive Education and Adventure Education, we strive to enrich human and digital interactions, as well as critical and creative collaborations. We are grateful that our critical, creative and collaborative relationship with Deloitte Centre for the Edge supports us in intersecting the science of learning with the art of teaching to develop discerning digital citizens.

Rebecca Cody

Principal
Geelong Grammar School

Should everyone
learn how to code ?



Should everyone learn how to code? A simple question with a seemingly obvious answer, though a question that was never fully addressed before the rush to teach everyone how to code. We – parents, educators and employers – assume that in a technological world we must choose to be tool maker or tool user, while also assuming that the ascendancy of our ever more capable digital technology is eliminating tool user as an option (it's commonly assumed, for example, that the development of autonomous vehicles will make bus and truck drivers obsolete).⁵ The rush to teach everyone how to code is seen as an obvious way to close the skills gap by ensuring that we're all tool makers, rather than tool users.⁶

It's not clear, however, that diagnosis and prescription are aligned. Most telling is the fact 'coding' means different things to different stakeholders. For some, 'learning to code' might mean preparing them for a web-development role. Others might want to be able to drive an analytics tool chain, working as a data scientist. It's even assumed that the trades will need to learn how to code, as how might a carpenter operate their numerically-controlled router if they cannot code? If coding is not a well-defined concept then what should we teach? And what is the educational outcome we're driving toward?

Framing the problem as one of a lack of digital skills – digital literacy and competency in general, and coding in particular – leads us to addressing the problem by investing in formal education. A skills gap – a gap between the skills employers seek and those job seekers hold – can be closed by teaching more, and more relevant, (digital) skills. We develop digital literacy frameworks and integrate them into the curriculum in the hope that more instruction will help. This is not working though, as despite investment over many years the skills gap continues to grow.

This essay takes the position that knowledge and skills are opposite sides of the same coin. 'Knowledge', the possession of facts, is *knowing*, whereas 'skills' is *knowing how to*. In practice the two are interwoven and inseparable. For example, when learning to sing (a skill) students must first learn the difference between singing, speaking, and by implication, shouting and whispering (facts). In the essay we use 'knowledge' to refer to *knowing* and 'skills' to refer to *knowing how to*.

In 2016, Deloitte Centre for the Edge and the Geelong Grammar School realised different stakeholders had dramatically different views on what coding (and digital literacy) comprised, and different views on the problem that integrating these digital skills into the curriculum was intended to address. Views ranged from the instrumental "in the future everyone will need to be a coder, or will be out of work" through to the more nebulous "digital technology is the modern alchemy, a black art that is taking over the world, and 'coding' seems to be the source of the alchemists' power". It seemed that the community had jumped from hastily naming the phenomenon ("the skills gap") to prescription ("teach digital literacy / coding") without considering the range of views across the community to understand what was really driving the anxiety we were all feeling.

Our response was to create a project – this project – to attempt to unpack what various stakeholders meant by "everyone should learn how to code", to understand why and how they were using the term, and (hopefully) to find the common problem that they were expressing in different ways. Our first action was to convene a national series of round tables, open discussions where diverse group of participants (teachers, policy makers at a systematic level, university experts, industry representatives, employers, parents, students) could share their points of view and find common ground.⁷ The methodology was deliberately kept simple: an open conversation with four questions

to guide its direction. After a brief introduction to set the scene, we would ask the first question before waiting for someone to chime in and the conversation to build. Subsequent questions would be used as prompts to move the conversation on once the current phase had played out. In their usual order of asking, these questions were:

- What do we mean by coding?
- What do we mean by digital literacy?
- What skills are missing from the current curriculum?
- How can we bring the community along?

Each conversation followed its own path, a path determined by the backgrounds and experiences of those in the room. However, despite this initial divergence, all the roundtables ended up with remarkably similar conclusions. First, they all concluded that coding is something of a black art, and a short, compulsory, introduction to coding would be beneficial. This might not require much more than a semester of coding in upper primary with a refresher in the middle of secondary. A compulsory course would help demystify coding (and digital technology) for many students. Some of these students might also discover that coding was something they would like to pursue as a career, a career they would not have otherwise considered. The second conclusion was that there should be an optional coding stream through primary and secondary (K12) education. Not everyone would want to pursue some form of coding as a career, but the community wants to support those who do. Third, and most importantly, the roundtables concluded that we needed to foster a productive relationship with digital technology, one where workers are comfortable working with digital technology, comfortable working in an environment saturated in digital technology, and where their inability to work with or navigate the technology is not holding them back in their work.



In this essay we use *work*, *worker* and *workplace* as generic terms. We define:

- **work** as any activity in pursuit of an outcome, paid or not, and where the desired outcome may be the journey rather than the destination;
- **worker** as an individual who undertakes *work*; and
- **workplace** as the physical and social content that the *work* takes place within.

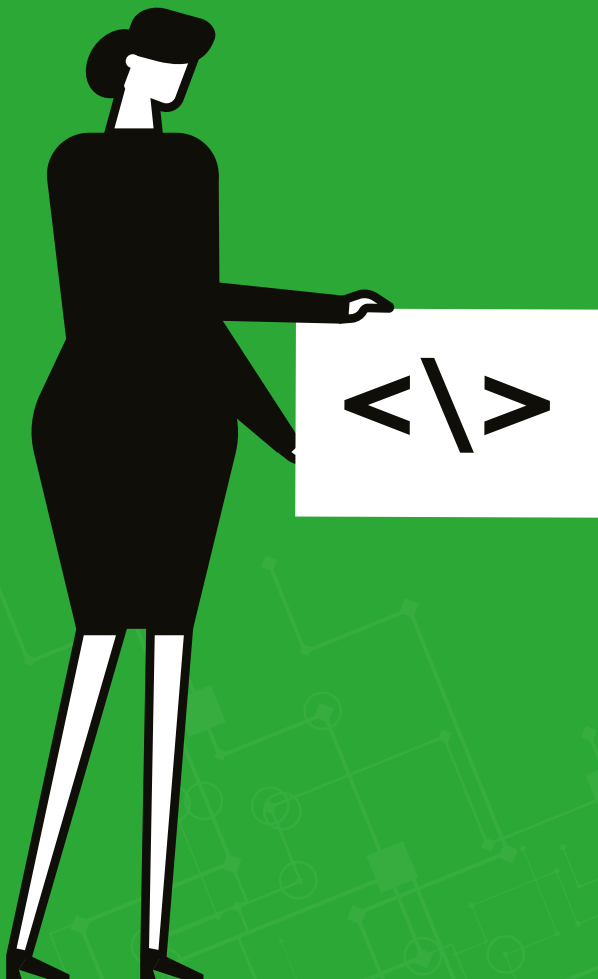
By using these terms, we are not implying a focus on paid employment or contractual arrangement. Work, worker and workplace can refer to an architect working in virtual reality to model a building just as it can to the same architect painting in their garden on their weekend as a hobby, where the desired benefit is primarily relaxation.

The question is then, what do we mean by “a productive relationship with digital technology”? Unfortunately, the roundtables could only describe the negative thing, situations when someone’s relationship with digital technology was holding them back. This became colloquially known as ‘the beer problem’, as one attendee at the round tables suggested that most employees can solve practical problems in the workplace, such as needing beer and snacks for Friday afternoon drinks – if I give them fifty dollars, they can find beer and snacks. However, if there is a digital technology problem, even a basic problem with their device, they cannot solve the problem unless there is an app for it”.⁸ A worker’s formal education was providing them with the knowledge and skills required to use particular tools in particular ways in particular contexts. However, the same education was not equipping workers with the ability to recognise situations when they might productively deploy a digital tool, either as the problem or context seemed unfamiliar.

They suffered from ‘learned helplessness’, where they had learned to use particular digital tools in particular way, and to raise their hand for more teaching if they found themselves with an unfamiliar problem or context.

None of the roundtables provided a name for the positive version of this phenomenon, when a worker is able to use their knowledge of digital tools to address new problems or new contexts.⁹ It was clear, though, that our existing language was insufficient for discussing the problem, which might have been why the community leaped from acknowledgement that there was a problem – the skills gap – directly to solution – digital literacy, digital competency and teaching everyone how to code. Moreover, when framed in terms of learned helplessness, our existing terminology increasingly appeared to be suitcase terms¹⁰ that we packed with our anxieties for a digital future.

Unpacking the suitcase



One factor limiting our ability to more effectively frame the problem is our unconsidered relationship with (digital) technology.¹¹ We assume an instrumental relationship with technology, one where there is tool user and tool maker. This has been true since the birth of the industrial revolution. Prior to then work was predominantly craft-based, and tool and technique were inseparable. Indeed, most craftspeople made their own tools. Since the start of the industrial revolution, the roles of tool maker and tool user have grown further apart, become ever more specialised. Many of us, for example, can drive a car but have no real understanding of the technology employed in the car's making. Today, with digital technology, we're confronted with ever more capable machines, machines that we anthropomorphise as 'thinking' or having 'agency'. Our anxiety for the digital future might stem from the intersection of the golem myth¹² and digital technology's ability to out-perform humans on what are seen as inherently human tasks, chess being the most obvious example. If our tools, our instruments, have their own autonomy and agency, then do they really need human users? We feel the need to abandon the tool user role, retreating to tool maker as the only viable human role in the future. Hence the rising perceived importance of digital literacy and the rush to teach everyone how to code.

Our relationship with technology is not so simple though. It's less a question of our tools making us redundant than understanding how our relationship with our tools is changing. Consider the telephone. Historically telephones have represented places, as the fixed-line technology used tied them to a particular location. These telephones provided a new capability – the ability to communicate at a distance – and our habits evolved to integrate them into our lives. We might call ahead before attempting to visit a distant friend, preventing disappointment. We would also collect the numbers of all our friends and write them down in a book that we kept beside the telephone. Race forward to the present day and

(mobile) phones represent people rather than places. We now realise that writing our friends' telephone numbers in a book that we keep in the hall beside the phone is no longer a productive habit. It's better to store the numbers in our phone so that they are always available. Having the skills to use a particular piece of digital technology is one thing, but having the attitudes and behaviours to make this piece a productive part of our life is a different thing, and this is true for employees, employers, teachers and students. As our technology evolves so must our relationship with it.

What's unique about digital technology is that it typically involves formalising reasoning ('thinking') in algorithms which are then automated by embedding them in applications, making them available to all. Google, and internet search engines in general, are a great example of this. Modern search engines mean that all (or nearly all) the world's knowledge is no further away than the ends of our fingertips. Why remember what we can google?¹³ Having all the world's knowledge available to us provides us with opportunities, but can mask the fact that it creates other issues. We can teach workers how to take a question and convert it to a query and thereby find an answer to the question, but the problem we have is what we aren't teaching (and possibly can't teach) workers is what questions they might, could or should ask and when might be an appropriate time to ask them. These questions might be anything from vague knowledge of a novel methodology that might be useful in this instance, through to particular strategies such as typing the name of the application and what we're trying to accomplish into a search engine and seeing what it throws back at us. What we are increasingly needing is an attitudinal shift, one which requires higher order thinking skills such as discernment.

The set of habits a particular worker uses to productively integrate Google into their work does not comfortably fit into the definition of *skill*, which we might take as

"the ability to do something well",¹⁴ nor does it fit with *competence*, "the application of a skill in a particular context".¹⁵ Finding an appropriate question to ask will depend not just on the work, the task at hand, but also on the workplace, the social and physical context of the work, and the worker. One worker's set of habits may not work for another worker as they have different lived experiences as well as relating to the work and workplace differently. An inability to find an appropriate question – if the worker cannot discern that there is a productive question to ask – is a source of learned helplessness (in this example at least).

If we're to understand the phenomenon behind learned helplessness then we need to delineate it differently, and not in terms of skills or competencies. Rather than trying to refine or modify existing concepts until they fit the phenomenon, we need to deconstruct the phenomenon and discover its parts, and then construct a new definition. So, we posed a new question: What are the attributes of a (productive) digital worker?

What's of interest in the *Why remember what you can google?* example, is that building a productive relationship with a search engine requires more than simply knowing how to transform a question into a query. Knowledge and skills are insufficient on their own. We need to develop a new set of habits so that we have a library of potentially useful questions at our disposal. More importantly, we need to develop the discernment that will tell us when one of the questions at our disposal might be useful and that it is an appropriate time to explore the question. Indeed, there is evidence that "knowing the technology is important, but knowing when and why to use it is more important."¹⁶

The corollary to this is that if we *know of* (rather than *know per se*) potentially useful knowledge or skills, and we have good judgement on its potential use in the workplace, then we can reach out and either learn it just in time (thanks to the wonders of the internet), or find someone else to deploy the knowledge or skill on



our behalf. Our *remembered knowledge* decreases while our *knowledge of* increases, providing us with command of a much greater body of knowledge, but only if we have a productive relationship with the technology used to organise, navigate and access that knowledge as needed. If not, and if we find ourselves in a workplace that relies on this technology, then we suffer from learned helplessness as we are unable to navigate the environment around us. (There was a similar transition with the development of the written word, which is a technology, as discourse and reading have different affordances and challenges. The written word enables us to eternalise and organise a greater body of knowledge than we could remember. Socrates, though, is well known for his dislike of the written word as you could not interrogate it as one can in discourse, to explore all the nuances.)

Work today is rarely a solitary affair, as the complex problems we work on require teams that integrate a diverse set of skills in a complex digital environment. It might be said when firms hire that they are focused on *building the peloton*¹⁷ rather than hiring the individual. What's important is that the team collectively has access

to all the knowledge and skills it needs to prosecute the work, not that the individual has all the knowledge and skills that the work requires. This just underlines the importance of individual workers having the discernment to understand when and why it is appropriate to deploy a technology, rather than only knowing how to deploy it.

We also need to consider the temporal aspect of the *Why remember what you can google?* example. If we're to have a library of questions and strategies to deploy while working then something must have happened *before* we embark on the work to populate this library. Similarly, if we want the overall quality of the questions and strategies contained in our library to improve over time then something must have occurred *after* the work to weed the library. And clearly something must have occurred *during* the work, when we decided that it was worthwhile and appropriate to access our library of potential questions and strategies.

With this we can attempt to delineate our phenomenon.

On the horizontal axis we might place time, breaking it into three sections: *building* the library before the work, *discerning* its use during the work, and *curating* its content after the work. The vertical axis can be broken into two sections. On the top are attitudes. If the worker is to do something before, during or after the work, then they must have an attitude that shows they value doing these things. On the bottom are behaviours: the actions the worker takes to realise the value declared in the associated attitudes. We can gather these sections together and consider it a *predilection*. The name predilection was chosen as it suggests both a bias toward particular attitudes and behaviours while also implying that these attitudes and behaviours can be acquired and modified (and are therefore learnable), that is, they are not some essential and unchangeable attribute of the individual.

Figure 1: A predilection

Predilection

A descriptive name

Building

Discerning

Curating

Attitudes

Does the worker value investing their time before the work to prepare?

Does the worker value investing time while they're working, to experiment with and evaluate alternative approaches?

Does the worker value investing time after work, to consider how effectively they used digital technology?

Behaviours

What actions, processes, and strategies does the worker use to prepare for the work?

What actions, processes, and strategies does the worker consider to best engage with the work?

What actions, processes, and strategies does the worker have to evaluate how effective their use of digital technology was?

Consider *Why remember what you can google?* Before the work the worker must value investing time in discovering, becoming aware of, new questions and strategies. This might be realised as a collection of simple behaviours, such as watching a TED talk over lunch, reading books or journals, dinner with colleagues, or even just asking a co-worker to explain a search strategy they had just used. It doesn't matter which behaviours the worker adopts, as long as, collectively, they populate their personal library. During the work, the worker must have an attitude that it is worthwhile considering new or

different approaches to solving a problem. This attitude is realised by a collection of behaviours that the worker uses to realise the value latent in the attitude in different work contexts. When time poor and mobile they might make a note to consider some question that comes to mind, which they'll revisit later when they have time and better access to a search engine. They might do the same if the thought strikes them while sitting at their desk, but just before a meeting. However, they might revisit their notes while sitting with their iPad in front of the television, investigating what was noted. The next day,

when they're at their desk and time is not so tight, they might consider using what was noted. Again, the composition of their collection of behaviours doesn't matter as long as, collectively, they are productive. What matters is the worker's judgement on which behaviours to deploy, which tool(s) to employ, and which ideas are worthy of attention. Judgement is the fulcrum that balances attitude and behaviour and determines if the worker's predilection is productive. A similar example can be made for their attitude and behaviour after the work, as shown in figure 2.

Figure 2: Why remember what you can google?

Predilection

Why remember what you can google ?

Building

Discerning

Curating

Attitudes

I want to build a library of questions and strategies that will help me integrate search engines into my work

While working I'll take the time to explore alternative approaches or ways to frame the problem

After working I'll consider how well I worked, modifying and keeping the good techniques while rejecting others

Behaviours

- *Watching TED talks over lunch*
- *Attending conferences*
- *Reading blogs and books*
- *Open discussions with colleagues*
- *Asking a friend what they did*

- *Consider alternative approaches when stuck*
- *Use less sensitive projects to experiment with new ideas*

- *Maintaining a commonplace book of what worked and what didn't*
- *Contributing to conference talks and panels*

Constructing a new definition



With this we can consider (re)constructing what we mean by the attributes of a productive digital worker.

A productive digital worker must have a suitable set of digital predilections (the judicious combination of competences and attitudes balanced by good judgement – discernment), as these will determine how they integrate the associated digital tools into their work habits. As we saw with both *Why remember what you can google?* and the telephone example, inappropriate or insufficient predilections result in an unproductive relationship with technology and learned helplessness. Our productive digital worker must also have a suitable set of digital abilities, the knowledge and skill required to accomplish particular tasks with the relevant digital tools. *Why remember what you can google?* clearly relies on the ability to take a question or strategy and convert it into a search query. Finally, our productive digital worker must have a suitable set of digital literacies. This is literacy in the old sense, implying knowledge of a language and its major works. Spanish and Don Quixote, for example. The digital equivalent would be knowing how to interact with a tablet – the ‘language’ we use to interact with a touch device – and how to access web applications (such as a search engine) from this device. It’s more natural to list these in the reverse order, which provides us with the following definition.

The attributes of digital workers include:

- *Digital literacies*: understanding of digital media and their major platforms, literacy in the old sense
- *Digital abilities*: knowledge and skills to use digital tools
- *Digital predilections*: attitudes and behaviours to form a productive relationship with technology

Let’s consider a different example from the near future: the digitalised construction industry.¹⁸ As Deloitte Centre for the Edge has documented elsewhere,¹⁹ the construction industry is poised to transform from the craft- and process-driven industry that dates back to the pharaohs, into a digital manufacturing process, a Design for Manufacture and Assembly (DFMA) approach. (The description of this scenario, which was used in the workshops discussed in the following section, is included in figure 3).

A hyper-accurate model of the building to be built – a *building information model* (BIM) – sits at the heart of the approach, with all work driven out of the model. The site is scanned and loaded into the model, site engineers sketch out the building volume then architects sculpt the facade and interior. Workflows are modelled and trialled in virtual reality (VR). The model is cut up and fed to a numerically-controlled production process hosted in a factory, with the resulting modules and assemblies delivered on site and installed. Current versions of this approach are 10% cheaper and 30% faster than a conventional approach, and improving all the time. They’re safer than a conventional approach as there’s no live edges (unguarded openings on the side of a multi-storey construction). And moving work to the factory enables the use of environmentally friendly materials (such as geopolymers which require curing in an oven that cannot be accommodated on a construction site but comfortably fit into a factory-based process).

It’s interesting to consider the digital attributes of the tradespeople in this scenario. Clearly, they need to be able to use a smartphone and laptop to manage the site paperwork, which implies the usual literacies with smartphones, laptops and forms-based applications. They’re likely to need some spreadsheet skills. However, they also need to sally into VR to help trial and improve workflows. This implies literacy with VR tools, and some basic abilities for working with a BIM in

VR.²⁰ Instructions for the tradespeople are delivered to them directly from the BIM to a networked tablet, so they also need literacies for tablets and some abilities for manipulating the BIM on the worksite. Part of their job is also to look for opportunities to improve workflows, or to improve the DFMA approach, so they also need the predilections to help them understand and notate the problems and opportunities for improvement, recording this information in the BIM.

It’s important to acknowledge that these attributes of the digital worker fall into two groups: digital literacies and abilities are *convergent* attributes, while predilections are *divergent* attributes. By convergent we mean that for a given problem there is a best approach to solving it and single correct answer. When convergent skills are taught in the classroom students are expected to *converge* on this best approach and the correct answer. Mathematics skills might be seen as the stereotypical convergent attribute, particularly at the junior levels, which is reflected in the rubrics used to mark maths problems,²¹ with a mark for the (single) correct answer and marks for each of the major steps in the most appropriate process for reaching that answer. Divergent attributes, on the other hand, don’t have a single correct answer. Often, as with work which is more fluid and less prescriptive than school-based assessment, there are many good answers and while we can compare answers and agree that one is worse, comparable to, or better than another, it’s not possible to apply a rubric to a single answer to determine how objectively ‘correct’ it is. Creativity might be the stereotypical divergent attribute. If we define creativity as “a new, relevant and appropriate idea or solution within a given context”,²² then we can see that for a given problem there will be many possible solutions. Some of these solutions will be good, others not so good. (Usually as the idea is not ‘appropriate’ as stated in our definition, such as paving one’s driveway with bacon,²³ which is clearly a novel idea but bacon is not an appropriate nor durable surface to drive on.) There are

Figure 3: A near-future ethnographic drama from the construction industry

Scenario

Construction

Scene

A modern modular construction process. Design and construction of mid-rise apartment and office buildings via a digitised, modular, off-site construction process. Support incremental improvement of the process

Players

- Customer
- Architect (exterior & interior structure), Designer (interior& furnishings)
- Engineer
- Building Inspector, Quantity Surveyor
- Project Manager, Trades

Plot

The building structure is sketched out via a parametric model by the Site Engineer, within site constraints. Facades and internal volumes are shaped by the Architect, with the parametric model constraining changes to ensure that what is modelled can be built. The designer selects internal furnishings and treatments.

Virtual and/or augmented reality views of the model are used by the Customer, Site Engineer, architect, designer, and building inspector to collaborate on the building's form and finish - the

digital model of the building acting as a common collaboration platform. The Engineers, Builders and Trades collaborate via VR to trial and improve on-site workflows, tweaking the design as a result.

Certification of the building is also done via the model as the process ensures that 'the model is what is built'. All building and compliance documents, and engineering drawings, for certification are generated directly from the model.

A bill of materials is generated for the modular building components to be produced in the factory, such as bathroom modules, and the materials are sourced. Instructions are generated for both the numerically controlled machines and Trades on the production line, and production starts.

A bill of materials and project framework (Gantt chart of some- such that represents the process constraints on the building activities) is generated for the on-site assembly. Instructions are also generated for on-site Trade. The Project Manager develops the project plan to sequence and manage - use digital tablets to interact directly with the digital building model and with the project plan.

Site personnel - trades etc. - are also involved in the improvement of the building process by identifying opportunities to improve operations - better ways of working captured in updated instructions, or changes to design details to simplify and streamline tasks - making everyone's time easier and save on time and materials.

also many different paths to a creative solution, though some paths might be more productive than others due to the social and physical context the worker finds themselves in.²⁴

This highlights an important aspect of divergent attributes, such as our predilections: how context is managed is important. A skill is the ability to apply a technique and/or tool to a problem to provide an outcome. Competence is the ability to prosecute a skill and solve a problem in a particular social and physical context.²⁵ (Secondary school leaving exams are an example of a competence, as students are required to demonstrate specific knowledge and skills in a particular social and physical context.) Predilections, however, are centred on how a worker navigates a changing context. If we return to the creativity stereotype, then we can consider how the worker might apply a creativity predilection in a meeting. They will need to have an attitude along the lines of “exploring new ideas is a valuable source of creativity and innovation”. They will also require a suitable collection of behaviours and good judgement in their application, and to be able to discern what is salient in this particular context. Imagine that we find our worker chairing a meeting with a group of co-workers. One of their co-workers makes a comment that is seemingly unrelated to the topic at hand. Our worker can choose to deploy a few different behaviours in response. These might include:

- Making a note of the comment and then moving on to ensure the meeting finishes on time.
- Launching into an open-ended exploration of the idea to see what new places it might lead the group to.
- Agreeing to allow the meeting to run 10 minutes over and using those 10 minutes to explore how the comment might be connected to the topic at hand, as clearly something inspired it.

Which behaviour they deploy is a question of our worker’s judgement, rooted in

the social and physical context they find themselves in. Their judgement will need to factor in the time constraints of them and their co-workers: is it late Friday and they can continue the discussion over drinks, or are some co-workers rushing to catch a plane immediately afterward? It will need to factor in social constraints: it’s late in the project and the team cannot afford distractions, or the comment is from a co-worker who always makes insightful, but oblique comments. Judgement is a tacit thing, factoring in known, unknown, and even unknowable variables, and relies on our experience in the work domain, and the social and physical context, and our ability to determine what is, and what isn’t, relevant. As was mentioned earlier “knowing the technology is important, but knowing when and why to use it is more important.”²⁶

The contextual nature of predilections – such as creativity – means that, in our view, they don’t easily transfer between domains.²⁷ The attitudes, behaviours and, most importantly, discernment and judgement developed in one context will be less productive in another context. This might be a change in social context (your previous employer valued creativity and made time for it, but your new employer is more focused on keeping to schedule) or a change in physical context (such as access to collaboration spaces). It might even be a change in digital context (moving to an organisation that has a very different digital environment, Mac to PC for example).

For a worker to have “a productive relationship with digital technology”²⁸ they must have:

- Digital literacy relevant to the digital context that they find themselves in, the intersection of their personal and professional digital environments.
- Digital abilities relevant to the domain and professional community they are working in, the intersection of their firm and the firms they work with.
- Digital predilections relevant to their work.

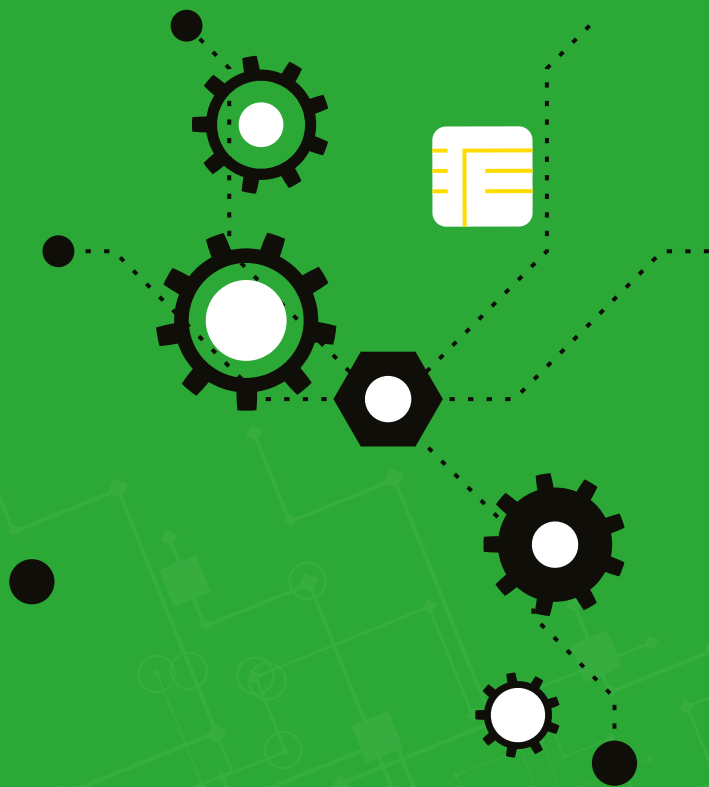
If the worker’s digital literacy is lacking then they will be unable to engage with the discourse of work. If they lack abilities then they will be unable to contribute to the work. If they lack predilections then they will find themselves limited, lacking agency in a digital environment, suffering from learned helplessness.

With this we’ve delineated the phenomenon that we are interested in – a phenomenon we discovered hiding behind “everyone should learn how to code” in those first roundtables – unpacked the concept and described its parts. Now it needs a name.

Initially, after the roundtables the authors used ‘digital competence’, but this was at the time that PISA, OECD and other national and multi-national education curriculum and standards institutions started to use ‘competence’ to refer to “the ability to prosecute a skill and solve a problem in a particular context”, which is clearly a different thing. The authors flirted with ‘digital fluency’ (which was used during some of the more recent workshops), but that was thought to be too closely aligned with language, and hence ‘digital literacy’. The phenomenon we want to name is more akin to cross-cultural navigation, rather than fluency within a domain.

The most appropriate name seems to be ‘digital agency’ as the phenomena we are focused on is a worker’s ability to productively act – work – within their chosen domain, their ‘agency’ in the digital world.²⁹

A mud map of the digital future





Understanding the (digital) attributes of a worker – their *digital* agency – provides us with a view of the worker at a point in time. It does not tell us how the worker reached this point, nor does it tell us how they fared in the future. If we're to help workers then we need to understand how their digital agency changes over time, as this leads to understanding how (and when) they acquired the relevant literacies, abilities and predilections, and, by extension we might support their acquisition in formal or informal education.

This raises a new question: "How does digital agency manifest at different stages of a worker's life?" Which leads to the follow-on question: "Can we build frameworks for assessing one's digital agency?"

In 2019 Deloitte Centre for the Edge and Geelong Grammar School convened a national series of workshops to explore how workers' digital agency would manifest and then change throughout their careers. The intention was to create a mud-map (a roughly-drawn map) of work in the future digital environment to explore the lives of digital workers in a diverse range of careers, and understand how their level of

digital agency helped in, or prevented them from, managing the challenges that work and life dealt to them.

The methodology for the workshops was driven by a set of 25 near-future ethnographic dramas.³⁰ These were short one-page dramas – scene, players and a rough outline of a script – that described a near future, one that uses today's technologies but which plays out current digital, social and physical trends five to ten years into the future. All dramas were developed in consultation with domain experts. The building example in figure 3, earlier, is one of the dramas used in the workshops. The workshop itself was designed as a series of structured conversations working through four questions³¹:

- What might the attributes of a future digital worker be? (What does it mean to have digital agency?)
- How might these attributes have changed over their career? (How might an individual's agency change over their life?)
- What are the common digital attributes of workers in a particular career stage? (How might – a lack of – digital agency affect them at life's milestones?)

- How and where in a worker's formal education might we foster these attributes? (Can digital agency be learnt?)

Each workshop found its own path – as the roundtables did in 2016 – with the unique collection of backgrounds in the room teasing out different aspects of the scenarios. Several groups, for example, decided to focus on players implied by a script, rather than a listed player. Participants also brought their own lived experience to the workshops, making them a much richer experience. And again – as with the roundtables – the conversations all found their way to the same place.

The workshops highlighted how we have implicit assumptions about how we use digital technology throughout our careers, and these assumptions are no longer true.³² We assume that as we move up through the ranks, that we'll move on from needing to directly use the digital tools which we developed expertise in in our formative years; e.g., a young spreadsheet jockey will move from building financial models to specifying and reviewing financial models, to requesting summary reports derived from the same models. This is not necessarily the case anymore,

as modern analytics endeavours to provide tools which all users can explore and interrogate the data with; while the junior ranks continue to build the models, we continue to directly manipulate and otherwise interact with these models well into our careers. Our digital skills evolve, rather than diminish over time, while the technology continues to evolve so that we can achieve more with the same skills. Old and incorrect assumptions need to be broken and new (and more appropriate ones) formed if we are to move forward.

The second common point was the importance of workers being able to negotiate with the digital environment they find themselves in, to discover the affordances it provides them and the autonomy it allows. With online collaboration, for example, the focus is usually on the skills required to manipulate the various digital tools used. What is not considered is that the workers are collaborating with workers from other firms, with each inhabiting their own digital environment. For the collaboration to be successful the workers need to negotiate a set of shared tools that meet the requirements of the work, and which are suitable for the social and physical context of the work. Factors they need to consider are the nature of the work product (which may be a written document), and how intermediate work will be shared and discussed (via email, instant messaging, or a wiki, perhaps). The digital tools chosen need to be usable in the physical environment (bandwidth constraints, for example). They also need to be culturally appropriate. If this negotiation is not successful, then the workers will find themselves in a fragmented digital work environment – emailing around files, trying to find who has the latest version – which will reduce the productivity of the team as a whole.

Third and finally, the workshops highlighted that the digital environment must be legible to the worker. Workers need to be able to build a mental model of the affordances provided by their digital environment, and the decisions and constraints it imposes on them. This was highlighted several times in the workshops, as a common problem raised was when workers couldn't understand or discover how to interact successfully with the various digital systems they depend on, or if someone couldn't do this on their behalf, then they would be confused and unable to obtain the services they needed – they would lack agency.

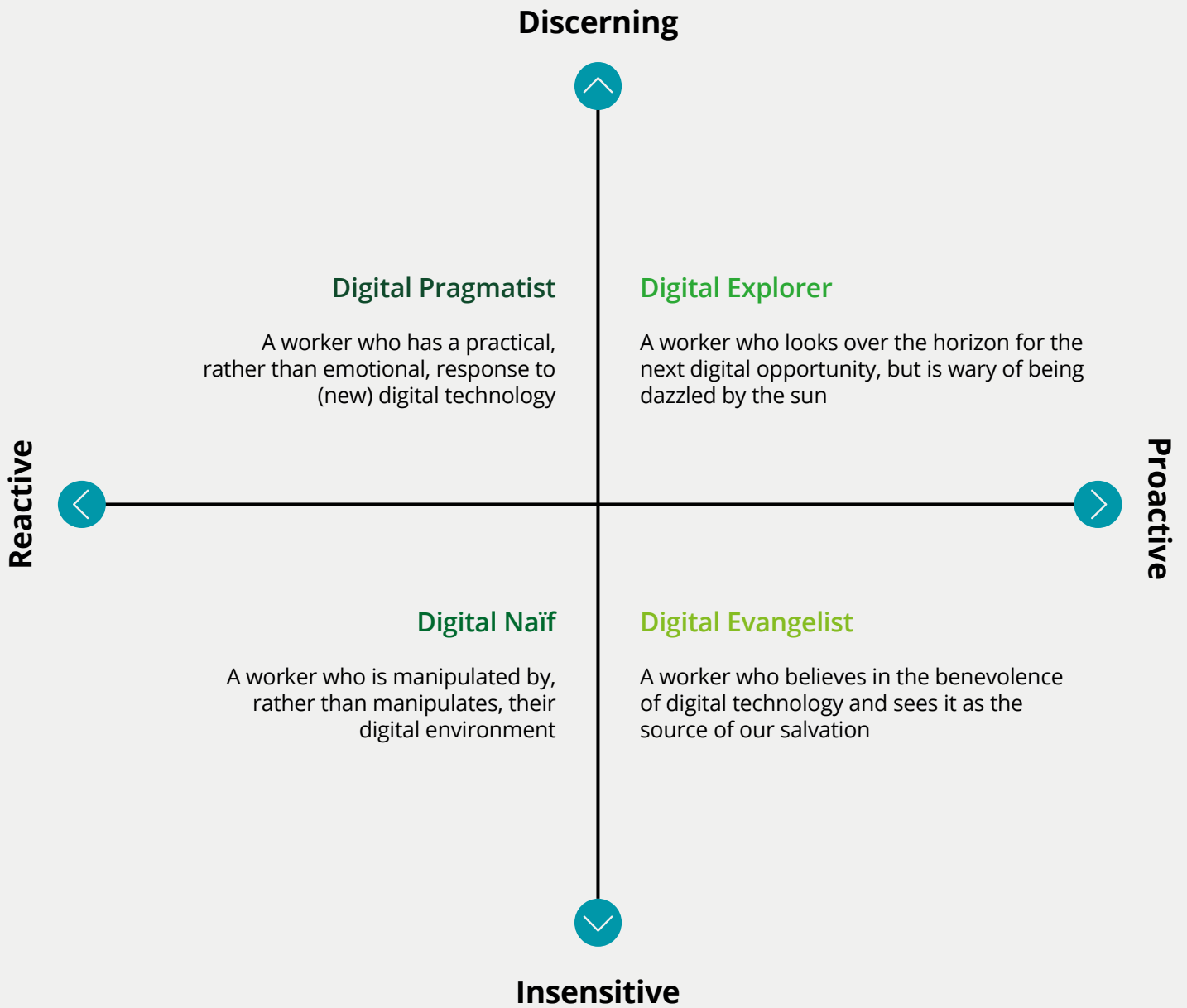
The workshops showed how the common dichotomy of digital natives or digital immigrants is unproductive. A number of studies have already established that digital natives neither use technology more often nor are they more proficient than digital immigrants, though nearly twice as many natives as immigrants rate themselves as digitally proficient as are actually proficient.³³ Similarly, a digital native's familiarity with digital technology does not protect them from learned helplessness.

A more productive approach is to frame our relationship with the digital workplace in terms of two different dimensions. First, we can consider how reactive or proactive the worker is with regards to integrating digital technology into their work and work habits. A reactive worker appreciates the benefits digital technology can bring to their work, but they will only seek out new digital tools when they discover that their current tools are insufficient for the task. In terms of their predilections, they place the emphasis on their *discerning & curating* (reactive) attitudes and behaviours. A proactive worker, on the other hand, appreciates the benefits digital technology can bring to their work, and actively looks

for new digital tools that will enable them to be even more productive. They put the emphasis on their *building & discerning* (proactive) attitudes and behaviours. Next, we can consider how discerning the worker is – how sensitive or insensitive they are – when applying digital technology to their work. A discerning, sensitive worker appreciates the potential impact of digital technology on their work and ensures that the digital tools they introduce improve their work, rather than detracting. In terms of predilections, they emphasise *discerning* attitudes and behaviours over *building & curating* ones. A digitally insensitive worker, in contrast, is focused on the new opportunities digital tools create, and doesn't have the same appreciation of the impact of these on their work. In terms of predilections, they emphasise *building & curating* attitudes and behaviours over *discerning* ones.

Using these two dimensions we can create a two-by-two which highlights four digital agency stereotypes, all of which were seen in one or more of the workshops, and which answers our first question for the workshop “How does digital agency manifest at different stages of a worker's life?”

Figure 4: Our relationship with the digital workplace.



In the bottom left we have the *digital naïf*.³⁴ A digital naïf is limited, has little digital agency, as they only know how to use particular digital tools in particular ways, in particular contexts, and their work is constrained by their narrow grasp of digital technology. Theirs' is the tribal knowledge of someone who might have grown up with the technology and is confident in their abilities with it, but they never developed the predilections to make the technology a productive part of their life.

A *digital pragmatist*, top-left, has developed the ability to determine when digital technology adds to, or detracts from, their work. Their grasp of digital technology does not limit their work. They place work at the centre, only pulling in new digital technologies when they realise that the tools they have at hand are insufficient. On the top-right is the *digital explorer*. Like the digital pragmatist, they understand the benefits and problem of digital technology, and their grasp of digital technology does not limit their work. Unlike the digital pragmatist through, they actively seek out new digital technologies and tools, technologies and tools that may make them more productive, or which may create new opportunities.

Finally, on the bottom-right, we have the *digital evangelist*. They are likely a digital naïf who, at some point, became enamoured with technology. While they are enthusiastic about the opportunities that digital technology provides, they are insensitive to how it affects the work. This puts the digital evangelist in the perverse position that their interest in the technology may actually be destructive.

It's important to note that discernment is not the result of familiarity with (or enthusiasm for) digital technology. Understanding *when* and *why* it's appropriate to use digital technology requires workers to explore different problems in different contexts, to discover how introducing digital technology changes the nature of the solution. Consider elections, where the gold standard is a paper-based process despite broad support in the community for digital voting. If we frame elections as an algorithmic problem (by focusing on voting) then the benefits of digital voting are obvious: improved accuracy (no 'hanging chads'³⁵, 'lost ballot boxes', or 'endless recounts') and efficiency through automation of a manual process. The most significant problems with running an election, however, typically do not hinge

on efficiency. What is most important is enabling citizens to vote anonymously and secretly (so they cannot be coerced nor sell their vote) while ensuring that they only vote once (by identifying that they have voted), and to convince the losers that they lost (by enabling them to validate that the voters' intention was correctly recorded and counted). None of these things are currently possible with digital technology. Knowing how to frame the problem appropriately to understand the (potential) impact of digital technology relies on one's discernment which, in turn, depends on your experience in the domain, knowledge of the capabilities and problems of digital technology, and in applying digital technology to problems in the domain.

Finally, we should note that digital pragmatist and digital explorer are equally valuable, though different, ways to approach digital technology. Ideally teams would want a balance between pragmatists and optimists. Too many pragmatists and new digital tools, and new opportunities to use digital tools, will be ignored. Too many optimists and the team will spend too much time chasing after new digitals or experimenting with digital tools that provide only a modest improvement at best.



Can digital agency
be learnt?



The two-by-two model (figure 4) presented in the last section provides us with a means of understanding how a worker relates to digital technology and the digital workplace, and whether this relationship is productive or unproductive. We might imagine that we all land in the digital naïf quadrant once we're handed a digital tablet at six months old. Some of us will develop a particular fascination with digital technology, moving from digital naïf to digital evangelist. By the end of our formal schooling hopefully we've moved up to either a digital pragmatist or explorer. The length of our career may see us moving between digital pragmatist and explorer, depending on our other priorities in life and the context we find ourselves in.

Our challenge then is to maintain our level of digital agency – our competence – when confronted with life's challenges. These challenges may force us to shift contexts – changing jobs, perhaps, to advance our career, or making time to care for a dependent child, parent or partner. Digital agency is contextual so each change of context will cause a dip in our digital agency, ideally never dipping down into digital naïf or evangelist. If we're to foster digital agency in our students then we need a framework to qualify their digital agency (the second question which drove the workshops). To do this, we've adapted a common competence model that works through four levels: unconscious incompetence through to conscious incompetence and conscious competence to unconscious competence. If we develop labels and descriptions for each of these levels, and describe how the components of digital agency (literacy, abilities, predilections) develop as one moves through the levels, then we arrive at the digital agency progression shown in figure 5.

Figure 5: Qualifying one's digital agency

	Small Digital Agency	Little Digital Agency	Pro Digital Agency	Big Digital Agency
	The accidental agency of 'digital natives'. An informal understanding of popular digital tools	The collaborative digital agency required to navigate a community. Able to negotiate the use of common digital tools with acquaintances	The deliberative digital agency of the professional. Capable of applying known digital tools to new tasks in the pursuit of their work	The considered digital agency of the exceptional individual. Mastery, combining tools from different domains to discover new ways of working
Literacy	Limited knowledge & skills of particular digital platforms and media	Knowledge & skills to navigate common platforms and media	Knowledge & skills for relevant platforms and media	Extensive knowledge & skills for a broad range of platforms and media
Ability	Applying particular tools to particular tasks	Apply particular tools to similar tasks and an understanding of their implications (privacy etc.)	Applying known tools to new tasks, discovering new tools and the ability to discern their intentions (algorithms)	Combining existing tools to create new solutions to new problems, moving tools between domains
Predilection	Only uses digital tools when and as directed ("learned helplessness")	Recognises when tools could be used, using tools in their proscribed manner	Recognises when a tool should be used, and has purposeful interactions with the tool	Realises when new tools are required, and shapes work habits/practices to suit

The two left columns are the lowest levels, where our digital naïf and evangelist live. Both of these columns represent a level of digital agency where the worker's agency is limited due to their inability to develop a productive relationship with the digital workplace. The distinction between the two columns being that individuals with *Little Digital Agency* (the second column) are aware of the problem, while those with *Small Digital Agency* (the first column) are not. The two right columns represent a productive relationship with the digital workplace. Workers with *Pro Digital Agency* and *Big Digital Agency* can confidently integrate digital technology into their work, though those with Pro Digital Agency will need to consciously apply themselves. Both Pro and Big Digital Agency are a good place to be, and we shouldn't insist that all students find their way to Big Digital Agency to be considered fully competent. Pragmatically we can expect that the majority of students will end up somewhere in Pro. Shifting contexts – moving from formal education to paid employment, changing workplaces, or shifting careers – will usually force a worker lower in competence, from Big to Pro or Pro to Little. Ideally a worker would dip no lower than Little, as Small implies that they are unaware of a (potential) drop in competence and, consequently, will not do anything to rectify the problem.

We can foster digital agency in students (as opposed to teaching)³⁶ via problem solving, by situating students in an increasingly complex series of digital environments and then presenting them with problems that enable divergent approaches and solutions. The challenge is to evolve learning programs (how curricula are enacted in the classroom) rather than change the curricula themselves.

Returning to the digital collaboration scenario discussed earlier, as an example, we might present students with a series of collaboration tasks during their K12 education, with the digital environment the tasks are situated in becoming more complex and open as students move into their later years.³⁷ The students' first

task – around grade six or seven perhaps, when the student receives their first personal laptop – is to form a group and collaborate on delivering a report. This is an open problem as the students may be using different digital tools (hardware and software) due to a school-wide BYOD (Bring Your Own Device) or 1-1 (one child to one laptop) policy, though the same policies will limit the diversity of hardware and software. Students need to be made aware of their unconscious incompetence: realising that we are limited is the first step in addressing these limitations. Consequently, the teacher points out that members of each group have different hardware and software, as well as different preferences for which digital tools to use. Students are encouraged to discuss how they will create the deliverable, how any intermediate work products will be created and shared, and how they will capture any discussions and decisions while they collaborate. After the task a teacher facilitates a discussion with the students, where they reflect on the quality of their collaboration and how their choice of digital tools, and their own preferences, affected the collaboration. Rubrics for the subject would be modified to capture the quality of their negotiation and its impact of the collaboration, as part of assessment.

In the middle years, students are presented with progressively more open tasks, tasks where there is more choice for the students. This might include different types of deliverables, and a broader range of collaboration tools (different tools of the same type, or different types of tools). The collaboration might also be between students in different schools, requiring remote communication as the students will only meet occasionally, as well as requiring students to deal with the schools' different digital environments. Multiple types of deliverable are now possible, and groups have greater choice in how they collaborate (something already supported by VCE and the International Baccalaureate). Students might negotiate the nature of their assessment task with a teacher, convincing the teacher that their chosen deliverable will demonstrate an appropriate level

of mastery of the problem they are collaborating on. The negotiation within groups is also more challenging. Greater choice in tools and methods mean that the students need to be more mindful of the relative advantages and disadvantages of different tools. Limitations in each school's digital environment (due to firewalls etc.) might also make some tools unreliable or inaccessible, or tools might perform differently at each site.

Towards the end of the formal schooling the students are presented with an open challenge. They may, for example, be connected with a group in an overseas school and presented with a general task. The students will need to contact each other, agree on how they will collaborate, refine the topic and decide on a deliverable, and then do the work. Students will need to accommodate (potentially) dramatically different preferences for digital tools, as well as managing time zones and the other challenges of working in distributed teams.

Similar approaches can be taken to embed other predilections – such as our initial *Why remember what you can google?* example – in the curriculum. This does not require the development of new content streams or subjects. A single predilection might be spread across a range of subjects. The first collaboration challenge, for example, might be presented in biology in year seven, the next in maths in year nine, then drama in year ten, and the final challenge in history in the students' final year. What is important is to ensure that each student, regardless of subject choice, has sufficient opportunities to work through the progression from Little Digital Agency to Pro Digital Agency by the conclusion of their formal education

The challenge then is two-fold:

1. Can we use a structured approach to discovering the predilections to be considered (and avoid the suitcase full of anxieties problem)?
2. How do we integrate digital agency into existing curricula?

The first question can be dealt with by understanding how digital technology will be used in the workplace of the future. One key factor to consider is how our relationship with technology is evolving.³⁸ We're taking decisions, formalising them in algorithms, and then baking them into software and providing them with (some) autonomy. The resulting systems consequently have (some) agency, and are taking on roles in the organisation chart, either directly or by having the system mediating between humans. There's two dimensions to this.

The first is *authority*, as workers can find themselves working for a robot, working with a robot, or having to manage a number of robot workers. A ride-sharing driver might be the classic example of 'working for a robot' as it's the ride-sharing service that allocates the work and determines if the driver has done a satisfactory job. A finance trader supervising a team of trading bots is the other extreme.

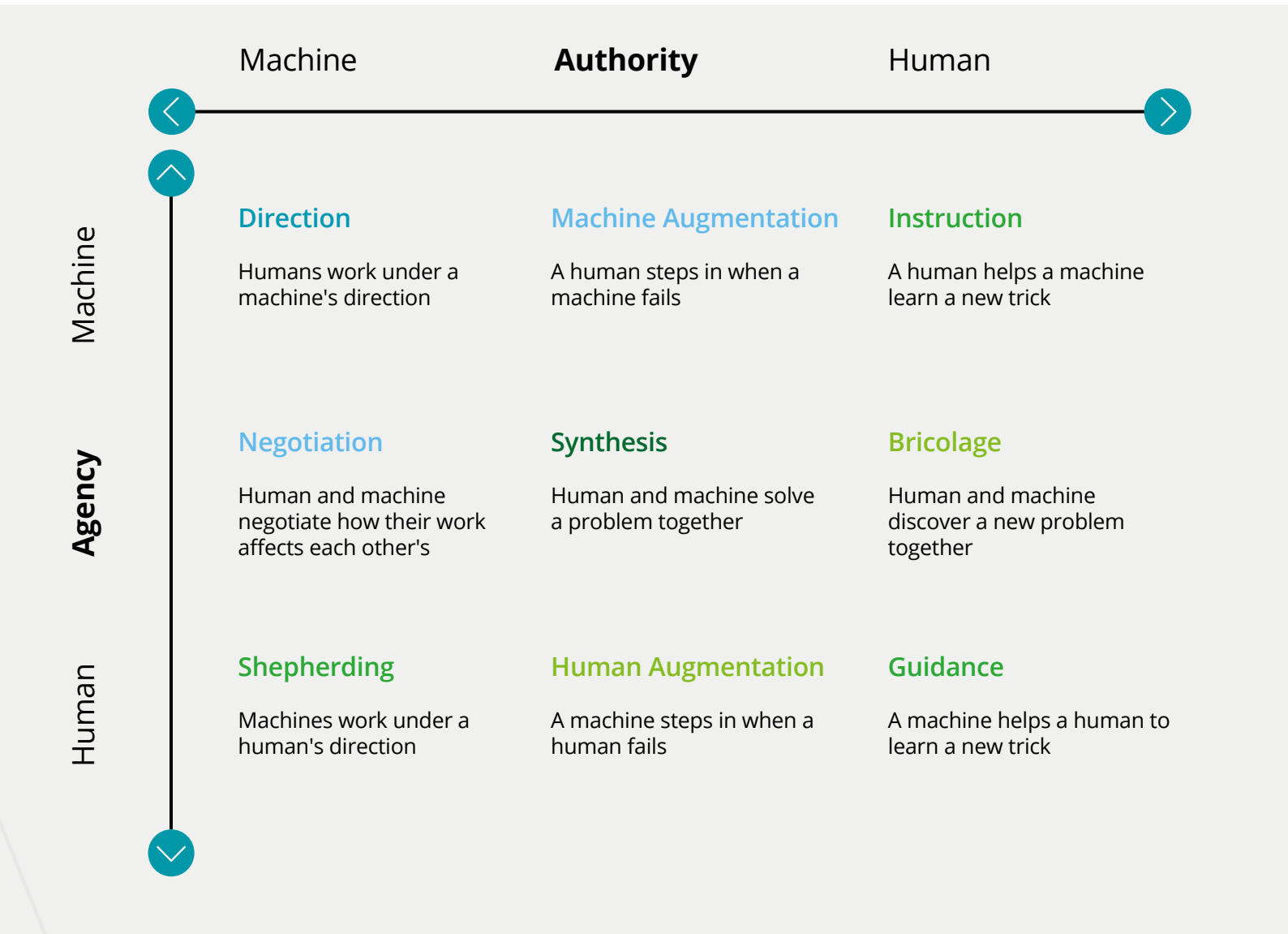
The second dimension is *agency*, as when human and (digital) machine are working together we'll find that sometimes the human takes the lead, in others it's the machine, while sometimes human and machine will collaborate as equals. Autonomous cars are an example of

human-assisted machines, as they are not truly autonomous at the time of writing, and require safety drivers to step in when they fail. Exploring medical images for cancer is an example of machines assisting humans: humans are superior at interrogating a potential cancer to determine if it actually is a cancer, but they need a machine's help to ensure that the human considers every possible cancer in an image, something humans find challenging on their own.³⁹

Combining these two dimensions creates a three by three matrix (shown in figure 6).



Figure 6: Our changing relationship with (digital) technology ⁴⁰



The structure of the three-by-three matrix was used to inform the development of the near-future ethnographic dramas used in the workshop, while the educational interventions developed can be used to roughly populate the matrix with potential predilections. Each cell in the matrix represents two predilections. The first is where a human and machine are working together, collaborating. The centre cell, for example, might contain freestyle chess, which is the stereotypical human-machine collaboration story.⁴¹ The second predilection is when humans are collaborating, mediated by machines. The student collaboration story previously mentioned is a good example.

Our final task is then integrating digital agency into learning programmes (the realisation of curricula in the classroom). Similar problems are being addressed by a new generation of specialist credentials, of which a Masters of Fintech is a common example. Fintech is the use of digital technology in finance, and the intention behind the Masters of Fintech is to provide students with exposure to subjects covering finance and digital technology.

Typically, these domains are kept separate, such as teaching students about trade finance as well as teaching them how to code. The assumption is that the finance and digital subjects will be integrated in the students' heads, resulting in graduates who can confidently navigate between the technology and finance domains. As we've seen in this project, however, familiarity does not confer competence or agency and graduates are likely to be digital naïf or digital evangelists as a consequence, and suffer from learned helplessness. There is a similar dynamic in school education where the development of digital curricula – even curricula that enable content to be exported from the digital and imported into the nondigital world – has not resulted in the integration of digital technology into non-digital subjects.

A more productive approach might be to sketch out the persona of a typical graduate (or a range of typical graduates), a persona that includes their expected domain knowledge, but also includes the attributes of their expected digital agency (this includes digital literacies, abilities, and predilections).

A modified version of the 2019 workshops used by this project might be suitable, where a set of near-future ethnographic dramas (used to imagine the digital workplace that the graduates are expected to emerge into) drive the development of a suitable set of persona. The digital agency attributes in the persona are then mapped across both the progression from figure 5 and the years of formal education (possibly only the candidates and graduates for a two-years Masters, every year for a three- or four-year Bachelors, and the stages of K12), aligning the digital agency progression with the students' progress through formal education for all of the attributes in the persona. The rapid change in technology means this mapping needs to be fluid – the skills we need now may no longer be necessary if the technology evolves, and so we need to balance educating for the needs of today with our best estimates of the needs of the near future. This provides us with a framework to identify subjects and the digital literacies, abilities and predilections that might be integrated into them.



Conclusions



“Everyone should learn how to code” might be a powerful call to action in a world full of anxiety for a digital future, but it’s not the foundation for a sensible education strategy. ‘Coding’ is a poorly-defined concept: if we narrow the definition to something teachable – a well-defined discipline with specific goals – then we’re not addressing the source of the anxiety. While broadening the definition makes it meaningless as (virtually) everything digital becomes coding. Our inability to resolve this tension has resulted in ‘digital literacy’ and ‘digital competence’ becoming suitcase terms that we’ve packed with our anxieties for a digital future, and is seen in our inability to successfully integrate digital and domain knowledge in the non-digital subjects.

The problem is that modern digital technology is different from the more instrumental technologies that preceded it. We’re taking decisions, formalising them in algorithms, and baking them into systems which give them autonomy. This endows these digital systems with a degree of agency – they’re not people, but neither are they instrumental tools – and consequently we have a different relationship with them than previous technologies. These digital systems are an integral part of the modern digital workplace and it is a worker’s inability to navigate and negotiate this digital workplace that is holding them back. It’s not enough to teach students *how* to use particular digital tools, they need to have the discernment to know *when* and *why* digital tools might be useful, and how using a digital tool will affect their work and themselves.

We cannot equip students with all the digital skills they need for their career (a Sisyphean task if there ever was one), not because the half-life of knowledge is contracting, requiring periodic re-education, but because a lack of particular skills is not the problem we need to solve. Indeed, we might conclude that the much publicised ‘skills gap’ is an artefact of how we’ve framed the problem. Rather than a lack of skills, what we’re seeing is a

lack of (digital) agency. Students lack the predilections (the attitudes and behaviours and, most importantly, the discernment) required to negotiate with and navigate a workplace that is increasingly shaped by these ‘somewhat human’ digital systems. If they lack the predilections required to navigate the digital workplace then they will lack agency, and suffer from learned helplessness. It *is* important for all students to do a little coding during their formal education, coding is seen as an black art and needs to be demystified. What is more important, though, is to ensure that all students have a productive relationship with digital technology – that they have ‘digital agency’ – by fostering in them the digital literacies, abilities and predilections (the elements of digital agency) which ensure that their relationship with digital technology is not limiting their ability to work.

Our challenge is that predilections are a divergent rather than convergent attribute. This means that there are many good answers (rather than a single correct one) and many productive paths to these answers (rather than a single most effective one). Current pedagogy and assessment does not easily support the teaching and evaluation of divergent attributes, and this must be addressed if we’re to move forward.

The good news is that this does not require us to ‘blow up’ the current education system – it’s a subtle change. We need to go into non-digital subjects in existing curricula and ‘reframe’ them, tweaking learning plans so that the students are situated in a digital workplace that presents them with an open problem to solve and access to a range of digital tools with which to solve the problem. At the lower levels this problem is open, but constrained, as the goal is to make the students aware that they need to apply their judgement to find a solution that works for them. As they progress through their formal education the problems progressively become more challenging and open up, allowing many possible solutions.

So rather than revolutionise our education system, instead we need to marry a taxonomy of potential predilections with an attributes progression that help us break each predilection into layers, from fostering a student’s first awareness of their digital agency through to mastery. Educational interventions are then focused on ‘reframing’ existing subjects, pedagogies and assessment practices – modifying them to integrate the problems and tools that will foster selected predilections.

It’s important to note that the progression of a single predilection is not tied to a single subject or domain, but might jump between them. Initial awareness might be fostered in drama, these foundations might be built on in science or maths, and a final polish applied in law. There are also opportunities outside of curriculum to foster digital agency. Many educational institutions have BYOD or 1-1 programmes, programmes that can be integrated into the curriculum by acknowledging that fostering the literacies, skills and predilections required for students to navigate and work in a heterogeneous digital environment is something worth their attention. Doing this will require them to create space in the curriculum for the learning, and to support teachers in doing this.

Care must be taken though, to ensure that each student’s journey through formal education passes through a set of interventions sufficient to ensure they graduate with a Pro or Big level of digital agency.

The focus of K12 education will undoubtedly be to move students from the lowest level of the digital agency progression – Small Digital Agency – to the middle two layers – Little and Pro Digital Agency. From initial awareness of their own agency through to a general sense of digital agency – a level that empowers them as digital citizens and workers – K12 institutions will ensure that all their

students can productively engage with the digital world around them. Students should graduate with an understanding of the role of digital technology in society – an understanding of the general *why* and *when* of digital technology. Digital Citizen of the Future might well be the title of the near-future ethnographic drama that K12 institutions use to drive this process.

Post-secondary educators will take the general sense of digital agency and refine it in selected domains. Our tradesperson (from our construction near-future ethnographic drama) will learn about constructing, the digital technology used in a modern DFMA construction process, and how to productively work in this digital environment, as will an architect (from the same drama), though the former attends TAFE and the latter tertiary. The challenge for post-secondary is to map the level of digital agency of their incoming students and the required level of their graduates, and schedule a set of interventions to close the gap. This requires them to imagine the near-future digital workplace – as the near-future ethnographic dramas used in the workshop did – to drive the reframing of subjects.

Finally, industry will take the domain-level digital agency of tertiary and post-secondary graduates and map this to the digital workplace. Every workplace is different, and every workplace is constantly evolving. New entrants to the workplace need to be supported, as their shift in context means that they won't have the same level of digital agency as they did in their previous job. Firms can map the particular digital literacies, abilities and predilections of a worker and craft a set of focused interventions that will ensure that the worker is productive in a couple of weeks, rather than a few months. (Indeed, this idea came from a HR team that attended the workshop series, and they had the intention of implementing it after the workshop.) Simply acknowledging that one's level of digital agency changes with a change in workplace means that we can do something about it.

Language is a powerful thing, and having appropriate names for the concepts and challenges presented to us is essential if we're to successfully address them. The challenge with "everyone should learn how to code" is no different. The project that this essay is the conclusion to was started when the authors realised that hiding behind that attractive call to action was a misunderstanding – different people were using the one phrase to refer to different things. Unpacking these different perspectives enabled us to discover the

problem hiding behind the call to action. What looked like a skills gaps and failure of the education system, was actually something different. Digital technology *is* changing the world, but not in the ways we assumed. Our assumptions are wrong and need to be challenged. The problem we really need to solve is how to build a productive relationship with technology that contains automated decisions and has a level of autonomy. Solving this problem means focusing on fostering digital agency in our students, not just imparting knowledge and skills. Doing this doesn't require us to rewrite curricula (the change to curricula might in fact be small) but it does require a significant attitudinal shift in education from knowledge and skills to attitudes and behaviours, from *knowing* to *knowing of*, and from only teaching and assessing convergent attributes to also teaching divergent ones.

This project has resulted in the creation of terminology (digital agency and its component attributes). It has also provided us with models for understanding digital agency in the workplace and in education. Finally, it has provided a workshop methodology for mapping digital agency in a particular social and physical context. It's hoped that, collectively, this language and these tools are something the community finds useful when discussing this important problem.



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Endnotes

1. Rumbens, D et al. 2019, *The path to prosperity: Why the future of work is human*, Deloitte, Australia, <<https://www2.deloitte.com/insights/us/en/focus/technology-and-the-future-of-work/building-the-lucky-country.html>>.
2. The GRiDDCompass, designed by William Moggridge for GRiD Systems Corporation, is generally considered to be the first modern laptop.
3. On the 3rd of April 1973, Motorola employee Martin Cooper made a call in New York on a Motorola DynaTAC.
4. On the 3rd of December 1992, engineer Neil Papworth sent the text "MERRY CHRISTMAS" to colleagues at Vodafone.
5. An obvious criticism of this view is that without tool users, tool makers will have no demand. However, the anxiety behind this assumption is more important than history, which shows us that jobs evolve as they integrate new technology rather than being eliminated, as it is the anxiety that is driving this rush to teach everyone how to code.
6. The importance of teaching every student how to code has been debated in the Australian parliament. See Cth. Parliamentary Debates. House of Representatives: 14 May 2015, No. 6., 26 May 2015, No. 7., 3 June 2015, No. 8. http://www.aph.gov.au/Parliamentary_Business/Hansard/. President Obama (when in office) started the "Computer Science for All Initiative". See Office of the Press Secretary, The Whitehouse 2016, 'FACT SHEET: President Obama Announces Computer Science For All Initiative', <<https://obamawhitehouse.archives.gov/the-press-office/2016/01/30/fact-sheet-president-obama-announces-computer-science-all-initiative-0>>.
7. The first report from this project has a complete description of the roundtables. See Evans-Greenwood, P & Patston, T 2017, *To code or not to code, is that the question?*, Deloitte, Australia, <<https://www2.deloitte.com/au/en/pages/public-sector/articles/to-code-or-not-to-code-coding-competence.html>>.
8. This anecdote is taken from the roundtables early in the project. Ibid.
9. A general term for this positive thing might be autonomous, goal-directed problem solving. While descriptive this phrase is somewhat abstract and none of the roundtables found a strong association between this and the positive thing.
10. 'Suitcase terms', or 'suitcase words', is a phrase coined by Marvin Minsky in *The Emotion Machine*. They are words or terms that are packed with a variety of meanings. See Minsky, M 2006, *The emotion machine: commonsense thinking, artificial intelligence, and the future of the human mind*, Simon & Schuster, New York.
11. This argument is adapted from Evans-Greenwood, P, Hillard, R, & Marshall, A 2019, 'The new division of labor: On our evolving relationship with technology', *Deloitte Insights*, <<https://www2.deloitte.com/insights/us/en/focus/technology-and-the-future-of-work/the-new-division-of-labor.html>>.
12. The golem myth is the narrative Western societies use to frame this rush of technology and which dates back at least to early Judaism, some 2,500 years past. All golems are created from mud and never fully human, and become increasingly destructive and out of control until their creator is forced to destroy them. The moral of this story is that creating life is a task better left to God, and our technology is something to fear. We can see the same moral on display in Mary Shelley's *Frankenstein*, through *The Sorcerer's Apprentice* from *Fantasia* to the *Terminator* franchise. We can also see it in the fear that the technological singularity, when general artificial intelligence emerges from our tinkering only to improve exponentially and push us aside.
13. In 2015 Deloitte Centre for the Edge published a report that did little more than ask the question: if our relationship to knowledge has changed then shouldn't our relationship with education also change? See Evans-Greenwood, P, O'Leary, K, & Williams, P 2015, *Redefining education: The paradigm shift*, Deloitte, Australia, <<https://www2.deloitte.com/au/en/pages/public-sector/articles/redefining-education.html>>.
14. Paraphrased from 'skill', Apple OSX dictionary.
15. This definition is a synthesis of 'competence' in common use. A dictionary definition of 'competence' is "the ability to do something successfully or efficiently". See 'competence', Apple OSX dictionary. The OECD 2030 project defines a 'competency' as "a holistic concept that includes knowledge, skills, attitudes and values". See FAQ – *Organisation for Economic Co-operation and Development* n.d., <<http://www.oecd.org/education/2030-project/teaching-and-learning/learning/faq/>>.
16. Kereluik, K et al. 2013, 'What Knowledge Is of Most Worth: Teacher Knowledge for 21st Century Learning', *Journal of Digital Learning in Teacher Education*, vol. 29, no. 4, pp. 127-140, <<https://eric.ed.gov/?id=EJ1010753>>.
17. A phrase the authors stole from Andy Peck, Partner in Human Capital at Deloitte.

18. This example is drawn from a near-future ethnographic drama used in the project's 2019 workshops.
19. Evans-Greenwood, P et al. 2019, 'Digitalizing the construction industry: A case study in complex disruption', *Deloitte Insights*, p. 15, <<https://www2.deloitte.com/insights/us/en/topics/digital-transformation/digitizing-the-construction-industry.html>>.
20. When the car was first invented, drivers had to be mechanically competent. We could have set up our education system to train all people to handle the mechanical complexities this involves. Instead, car manufacturers made the vehicle easier to use so there was no special literacy or competency requirements. We must assume that something similar will happen with the digital workplace.
21. Rubrics in general are convergent as they are trying to capture the possible ways of displaying a skill and so converging on an estimate of competency.
22. Taken from Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why Isn't Creativity More Important to Educational Psychologists? Potentials, Pitfalls, and Future Directions in Creativity Research. *Educational Psychologist*, 39(2), 83-96. doi:10.1207/s15326985ep3902_1.
23. Taken from *Teaching creativity in the 21st century* (edited) 2017, Deloitte Centre for the Edge, <<https://vimeo.com/342875189>>.
24. Creativity also requires knowledge and skills, as with the digital world.
25. PISA defines competency as the "ability to meet complex demands, by drawing on and mobilising psychosocial resources (including skills and attitudes) in a particular context." See Rychen, DS, Salganik, LH, & McLaughlin, ME (2001), *The Definition and Selection of Key Competencies*, OECD, <<https://www.oecd.org/education/skills-beyond-school/definitionandselectionofcompetenciesdeseco.htm>>.
26. Kereluik, K et al. 2013, 'What Knowledge Is of Most Worth: Teacher Knowledge for 21st Century Learning', *Journal of Digital Learning in Teacher Education*, vol. 29, no. 4, pp. 127-140, <<https://eric.ed.gov/?id=EJ1010753>>.
27. We note that this is the opposite to what is claimed in many conference keynotes, where creativity et al are seen as inherently human skills that transfer between domains.
28. This definition was developed during the roundtables. See Evans-Greenwood, P & Patstson, T 2017, *To code or not to code, is that the question?*, Deloitte, Australia, viewed 9 July 2018, <<https://www2.deloitte.com/au/en/pages/public-sector/articles/to-code-or-not-to-code-coding-competence.html>>.
29. We note that this is aligned with OECD 2030 concepts of agency and co-agency, though it focuses on the workplace rather than learning. See *Student Agency – Organisation for Economic Co-operation and Development* n.d., <<http://www.oecd.org/education/2030-project/teaching-and-learning/learning/student-agency/>>.
30. An 'ethnographic drama' integrates ethnography and drama to create descriptions of situations the enable us to explore the unspoken and embodied aspects of working situation.
31. A complete description of the methodology will be published separately.
32. C4tE is looking to address this with the Patterns of Work project.
33. See Scharping 2017, 'There Are No Digital Natives', *D-brief*, viewed 27 June 2019, <<http://blogs.discovermagazine.com/d-brief/2017/07/27/20443/>>.
34. Digital naïf is not a particularly pleasant term, but then it's not a pleasant place to be.
35. The recount of the 2000 United States presidential election involved debate over the validity of a punch-card vote where the punch failed to punch a hole in the card, leaving a 'hanging chad'. See '2000 United States presidential election recount in Florida' 2019, *Wikipedia*, viewed 16 July 2019, <https://en.wikipedia.org/w/index.php?title=2000_United_States_presidential_election_recount_in_Florida&oldid=903524108>.
36. We note that while it might be possible to learn digital agency it's not clear that it can be taught, as attitudes and judgement in students can only be influenced rather than instilled in the student via instruction.
37. Such collaboration tasks are an explicit part of many national curricula, including Australia's.

38. To see this argument fully developed see Evans-Greenwood, P, Hillard, R, & Marshall, A 2019, 'The new division of labor: On our evolving relationship with technology', *Deloitte Insights*, <<https://www2.deloitte.com/insights/us/en/focus/technology-and-the-future-of-work/the-new-division-of-labor.html>>.
39. We might call this the *Where's Wally* problem. While humans might be better at classifying potential tumors in medical images (as machines have a higher false-positive rate than humans), humans are not as good at finding potential tumors in an image as machines. We believe that we see the entire image when, really, we only see a small area where our attention is focused as it meanders over the image, with our mind filling in the rest of the details to create the illusion of seeing the entire image. This is why it's difficult to find Wally in an image filled with similar likenesses, as we only see Wally if we happen to look directly at him. AI, on the other hand, methodically scans the entire image. It might not be as accurate at identifying something as complex as a tumor, but it has a much better chance of finding it.
40. Figure 2. Our post-industrial relationship with technology from Evans-Greenwood, P, Hillard, R, & Marshall, A 2019, 'The new division of labor: On our evolving relationship with technology', *Deloitte Insights*, <<https://www2.deloitte.com/insights/us/en/focus/technology-and-the-future-of-work/the-new-division-of-labor.html>>.
41. Freestyle Chess is a common example of human-machine collaboration. See Guszczka, J, Lewis, H, & Evans-Greenwood, P 2017, 'Cognitive collaboration: Why humans and computers think better together', *Deloitte Review*, , no. 20, p. 24, <<https://dupress.deloitte.com/dup-us-en/deloitte-review/issue-20/augmented-intelligence-human-computer-collaboration.html>>.

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