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Our Reference: SCP_Submission_Parl_Inq_Creativity_080316.docx

8 March 2016

Submission to the Parliamentary Inquiry into innovation and creativity: workforce for the new economy

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Context

There's no point gilding the lily. So let's get the bad news out of the way first.

Up to 40% of today's jobs will be replaced through computerisation and automation by 2030. These nationwide estimates were contained in a June 2015 report prepared by leading researchers for CEDA, the Centre for the Economic Development of Australia.

These projections are within the bounds of similar research and analysis undertaken by Oxford University academics (47% of US jobs), PWC (45% of Australian jobs) and Deloitte (30% and 37% of London and UK jobs respectively). The types of jobs affected vary too. The *geographic* impacts also will be uneven. A map presented in the CEDA report shows that regional Australia is expected to be amongst the hardest hit.

Five possible responses

That's some pretty grim reading. Developing reasoned, cogent responses is without a doubt a necessity if our regions and cities are going to maintain - let alone enhance - standards of living into the future.

On the question of computerised labour substitution, there seems to be five broad types of responses. Each raises interesting and challenging questions about how best to prepare, and the limits of the kinds of preparations that are being canvassed by a range of public authorities under the rubric of STEM education.

1. As computerisation takes over job roles dominated by routines, the first

response is to ***pick up where the machine leaves off***. This involves moving to jobs that require higher cognitive capabilities. This move is consistent with the historical response to machine-based labour displacement. This move is likely to be supported by greater STEM capabilities, but not all higher cognitive occupations or roles are confined to the STEM disciplines. In many respects, a narrow focus on STEM subject matter or content knowledge will leave many without the broader cognitive capabilities to pick up from where the computer stops. It's not surprising that it's history and philosophy majors that are getting plenty of the good jobs in Big IT, for the simple reason that emotional intelligence and creativity are pivotal to a successful sale.

2. The second move is to ***find niches of specialisation***. These kinds of occupations and roles demand people who can be classed as genuine experts - that is, people for whom, according to Hubert and Stuart Dreyfus, have developed a level of skillfulness that enables them to smoothly navigate and cope with complex situations where intuitions of significance and relevance are pivotal (see below). This kind of skill is beyond the mere rote learning and repetition that characterises novices and even those with a high level of linear rules-based competencies. STEM knowledges are amenable to these kinds of specialisations but aren't the only bases for the kind of expertise we are talking about here.
3. A less onerous option is to ***fulfill supervisory and adjustment roles, overseeing the work of computerised processes and systems***. One suspects this response is short term in nature as routinised processes will progressively be computerised so that the requirement for human supervisorial capabilities diminishes increasingly over time. STEM knowledges are unlikely to be a defining skill set of those making this manoeuvre. It's the last bastion of middle management and the apparatuses of compliance.
4. The fourth option, not surprisingly, is to focus efforts on the human contribution to the ***creation of the next generation of machine competency***. Here, STEM knowledges are in their element. The new frontier is presently in the so-called Internet of Things, and the opportunities associated with monetising data and its analysis.
5. The last response is to focus on roles that ***benefit and draw from forms of intelligence that machines simply lack***. Long-term prospects exist for activities that are impossible without imagination, creativity and emotional

> and situational intelligence. These cognitive capabilities aren't readily replicable by computers, and the latter two kinds of intelligence presuppose a "background" of knowledges that make these kinds of human intelligences qualitatively different to algorithmic intelligence. STEM knowledge is not a direct contributor to these capabilities and intelligences.

Types of skill and intelligent competencies

Understanding the opportunity and limits to the present obsession on STEM education can be achieved when we have some kind of understanding of the way in which human being acquire and develop skills.

The Dreyfus brothers - one a philosopher, the other a computer engineer - start not from the idea that cognition is the primary locus of intelligence from which one builds out to an account of action, but rather, that *skillful activity itself is the consummate form and foundation of human intelligence*. An account of cognition is thus derived from this understanding of practical coping (see the recently published book *Skillful Coping* for more details).

When a person is engaged in skillful coping - when they are right "in the flow" or "in the zone" - their ability to stay in the flow or the zone is *not* dependant on a deliberative assessment of competing desires and motivations but on *the world drawing the person into and sustaining them* in a single clear course of action. This view of practical skillful coping does not require the mediation of mental or psychological states.

Rather, by learning and practice, the person becomes increasingly attuned to the world in such a way that the situation itself presents "reasons" for certain actions and in effect solicits a response. As Hubert Dreyfus in *Skillful Coping* says:

> *"past experience is projected back into the perceptual world of the learner and shows up as affordances or solicitations to further action."*

When people are engaged in learning contexts, according to the Dreyfus', the learner advances through five distinct levels of skillfulness:

1. *The novice* - rule dependant; maximally decontextualised; action governed by the application of rules and maxims;
2. *The advanced beginner* - ditto, but just better at it;
3. *The competent* - deliberation comes to the fore; affordances (perspectival affordances, opportunities, risks, expectations and possibilities) become more

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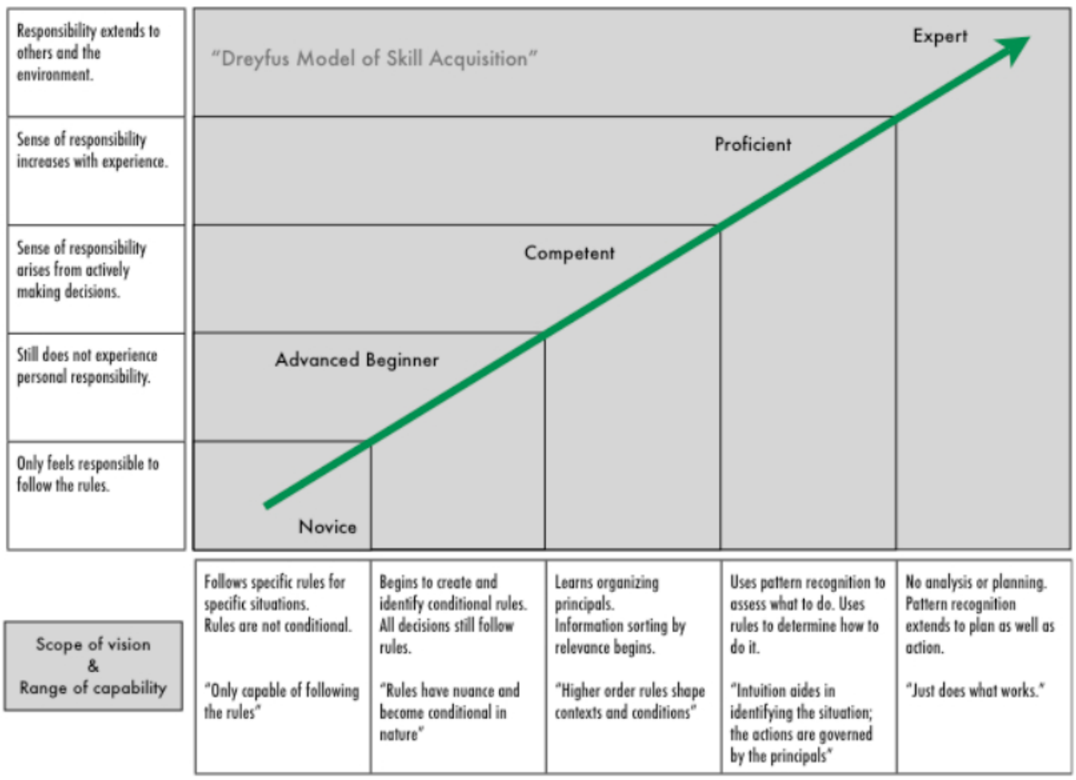
important in action-oriented coping; experimentation is frequent (trial and error);

4. *The proficient* - as per the competent but with more intensity;
5. *The Expert* - there are three broad types: (a) the *conventional expert*, who demonstrates an intuitive comfort in responding to well-known affordances to achieve regular bouts of success; (b) *mastery*, where solicitations lead to the meaning of the practice and world as a whole, and where new possibilities for continuing the practice in the face of conflict or tension with the situation become apparent, and (c) *radical innovator/creator*, where solicitations are articulated by marginal practices and success is determined by the ability to disclose new worlds (or establish new frames).



This progression sees the learner gradually weaned from a dependence on using rules and deliberating on aims and strategies and start responding more intuitively to the solicitations of the environment. (Note that a learner is not bound to progress through each stage, but can readily "skip" stages.)

Low levels of skillfulness tend to perceptually decompose the world, simplifying objects as it were. At its most basic level, the novice is taught to discriminate features of the world in a maximally decontextualised way. An advanced learner acquires more nuanced skills; that is, the ability to recognise the significance of things within specific contexts or situations. Eventually, a person - with sufficient training and experience - can become an expert. The decontextualised rules and maxims are a long way behind them by now.

No silver bullet

STEM education in an era of mass computerisation of employment will have only limited purchase on enabling populations to make the adjustments necessary to these dynamics. STEM is no doubt a powerful set of knowledges and competencies; so the claim here isn't that STEM should be abandoned.

Rather, my claim is that STEM isn't a silver bullet. It doesn't warrant it; nor does it deserve the pressure.

STEM is particularly relevant for skillfulness levels 1-4a; however, when we start pressing into the kinds of skillfulness attributes that mark out a "master" or a "radical innovator/creator" from a conventional expert, narrow STEM competencies necessarily fade to the background.

Mastery and innovative-creative capacity is driven by other skills - the ability to disclose new worlds, which is only possible through the active engagement of humanity's creative and imaginative faculties. (Of course, we can have mathematical and scientific innovators, but the forces of creativity don't emanate from the rules/maxims of the subject matter *per se*.)

There's recent historical experience, which provides some eerily parallel experiences. I am thinking of the IT and knowledge-based industries craze of 1998-99, which ultimately resulted in the Dotcom bubble (and the bursting thereof) in 2000. During this craze, an earlier variant of STEM became all the rage. IT was the hot button course, together with a massive boost in public (read government) support for biosciences. Hundreds of millions of dollars were spent on both, and thousands of people flooded one IT degree or course after another.

Within ten years, IT skills were "dime a dozen", pay grades had fallen relatively, and young people preferred a job in the mines or in a trade. The construction and mining booms of 2004-07 were far more attractive. Some in IT claimed there was a surfeit of IT competencies, and many of the technical knowledges learned during the earlier period were rapidly superseded, off-shored or computerised. Many had acquired either competence or proficiency, but few had advanced to the various permutations of expertise, which would enable adaptive coping.

When we look closely at the kinds of responses that are conceivable in the face of computerised labour displacement, it is reasonable to argue that STEM competencies can and will play a role in the employability of many. However, *the durable roles are those that presuppose a skillfulness that is beyond the reach of formal STEM content education*.

Instead, their durability is ultimately premised on a human skillfulness and cognitive capacity that remains difficult for machines to replicate for the very reason that they are humanly unpredictable. I am talking about the essence of being human, whereby we are disclosers of the world through our creative engagement with it.

Making our heart sing

We thus need a broader focus beyond STEM if we are to meaningfully and successfully respond to the expanding scope of computerised labour replacement. There's therefore some sense to turning STEM into STEAM; the "A" being "arts". As the late Steve Jobs observed:

> "… technology alone is not enough – it's technology married with liberal arts, married with the humanities, that yields us the result that makes our heart sing."

In the mad rush to STEM, let's not make the mistake of thinking that machines are becoming (or have become) a better version of ourselves, and that we are nothing more than a lesser version of the machine. We need to realise that a world of automatons doesn't make our heart sing.