The pedagogy of technical and vocational skills: Robotics and beyond in the South African school curriculum

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Presentation to the NSTF discussion forum on *STEM education - disruptions and the future*

29th August 2022

Centre for Researching Education and Labour

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

‘Robotics and Coding’ in the SA school curriculum

- In principle, correct.
- Policy construal, a curriculum setback.

“[it] is more skills focused than theory focused, … The *4IR needs more skills taught to learners* and not just a change in focus of subjects that are already offered” (Motshekga, 2020).

The necessary theory is deemed covered elsewhere in the mainstream technology curriculum (even though far more learners will study Robotics and Coding than technology subjects).

Motshekga, A. (2020). Written Reply by Minister of Basic Education to Question NW2866. Parliament of the Republic of South Africa [Hansard], Nov 27.

Amendments to CAPS

FP – ‘robotic skills’ acquired vicariously in play using digital devices, robot games and digital toys.

INTERSEN – ‘robotic skills’ - ‘output devices’ (diode lights, buzzers, etc.) and ‘input devices’ (buttons, sensors, etc.) in robots, and ‘automation’; and “coding skills’ - ‘number variables’, ‘text variables’.

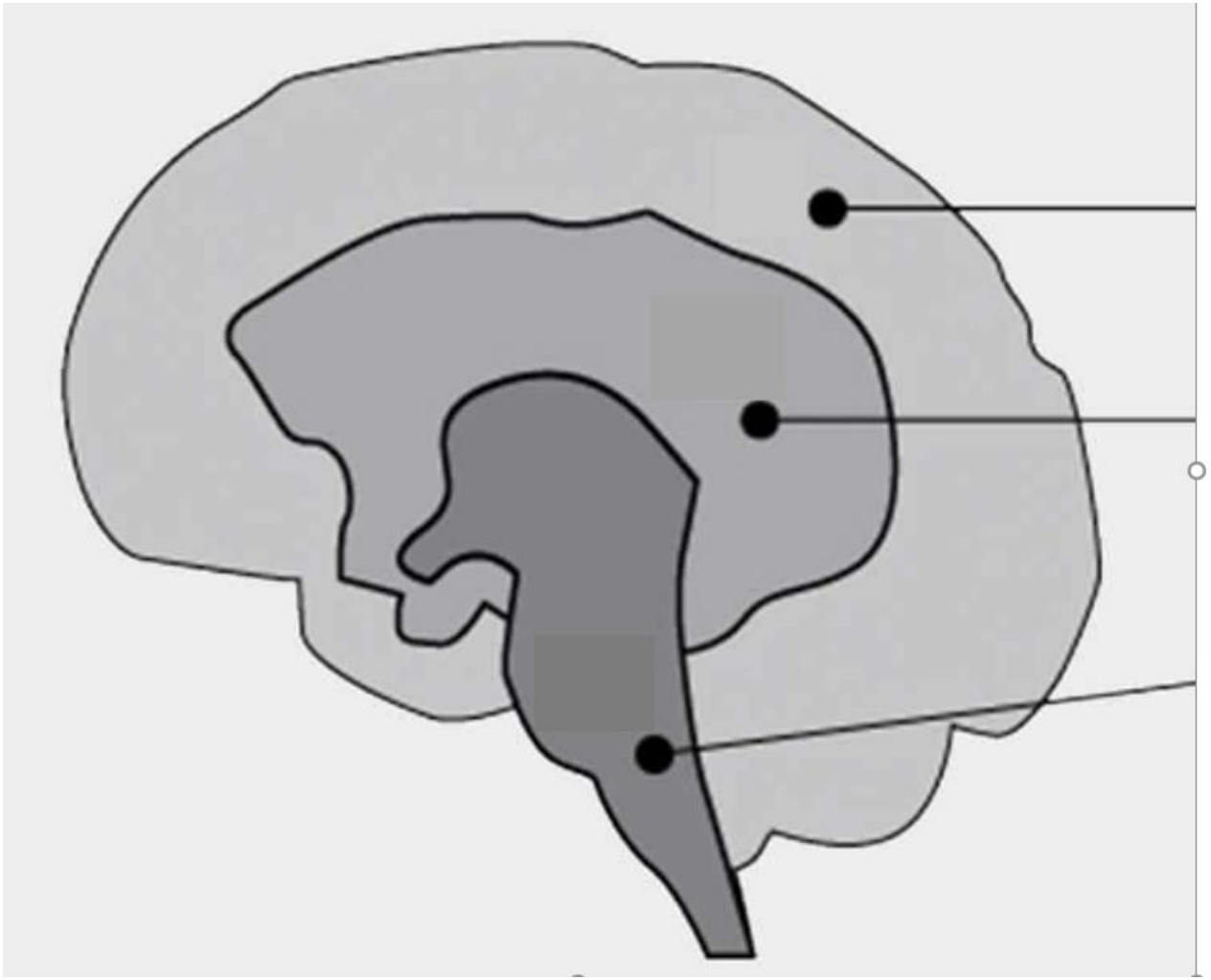
SP – (i) generic skills – problem solving, critical thinking, collaboration, creativity – related entirely to digital technology (ii) specific coding skills, including of simple microcontrollers in robots.

Republic of South Africa (2020a). *Proposed amendments to the Curriculum and Assessment Policy Statement (CAPS) to make provision for Coding and Robotics Grades R–3*, Pretoria: Department of Basic Education.

Republic of South Africa (2020b). *Proposed amendments to the Curriculum and Assessment Policy Statement (CAPS) to make provision for Coding and Robotics Grades 4–6*, Pretoria: Department of Basic Education.

Republic of South Africa (2020c). *Proposed amendments to the Curriculum and Assessment Policy Statement (CAPS) to make provision for Coding and Robotics Grades 7–9*, Pretoria: Department of Basic Education.

Neuropsychological dimensions of *skill*



neocortex
cognitive constructions
(knowledge)

limbic brain
feelings
(motives)

crocodile brain
emotions / reflexes
(instincts)

The emotional level of ***skill***

(instincts)

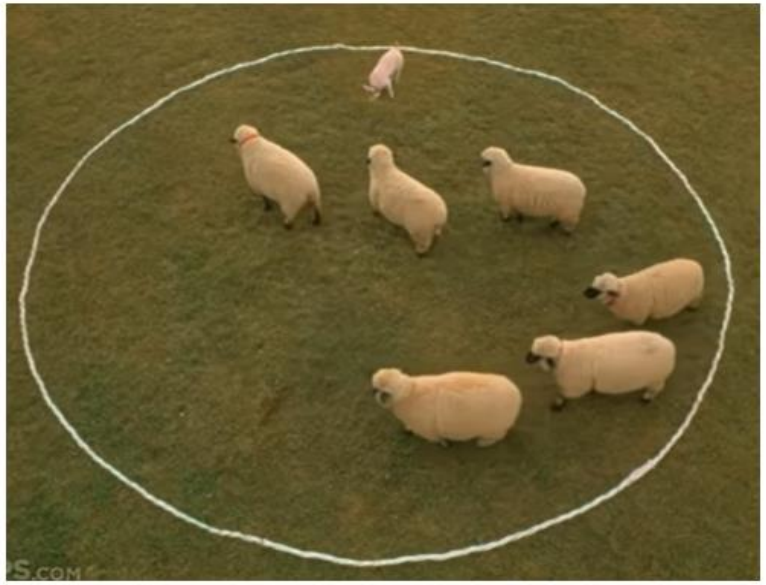
Top Crocodile Hunting Moments https://www.youtube.com/watch?v=kGz2svYtCN8

“instinct” ?

Taylorism – select each man [sic] for each discrete task in a “scientifically determined” division of labour.

“a man who is fit to handle pig iron … [must] be so stupid and so phlegmatic that he more nearly resembles in his mental make-up the ox than any other type… the man who is mentally alert and intelligent is … unsuited to … the grinding monotony of work of this character” (Taylor, 1911, p.59).

The affective level of ***skill*** – feelings as cognitive representations – motives)



Babe 1995

3

1

Pig 2021

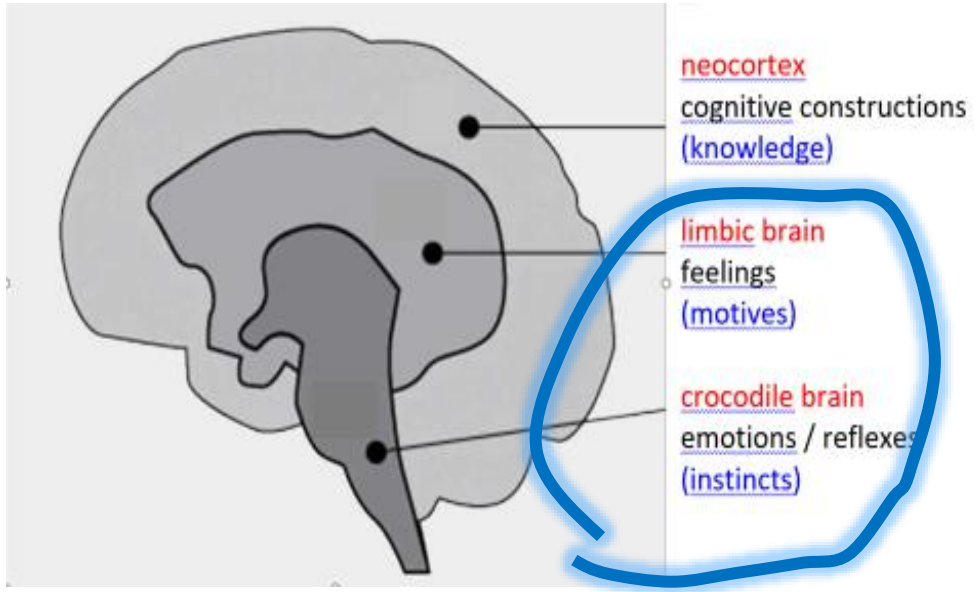
2

2

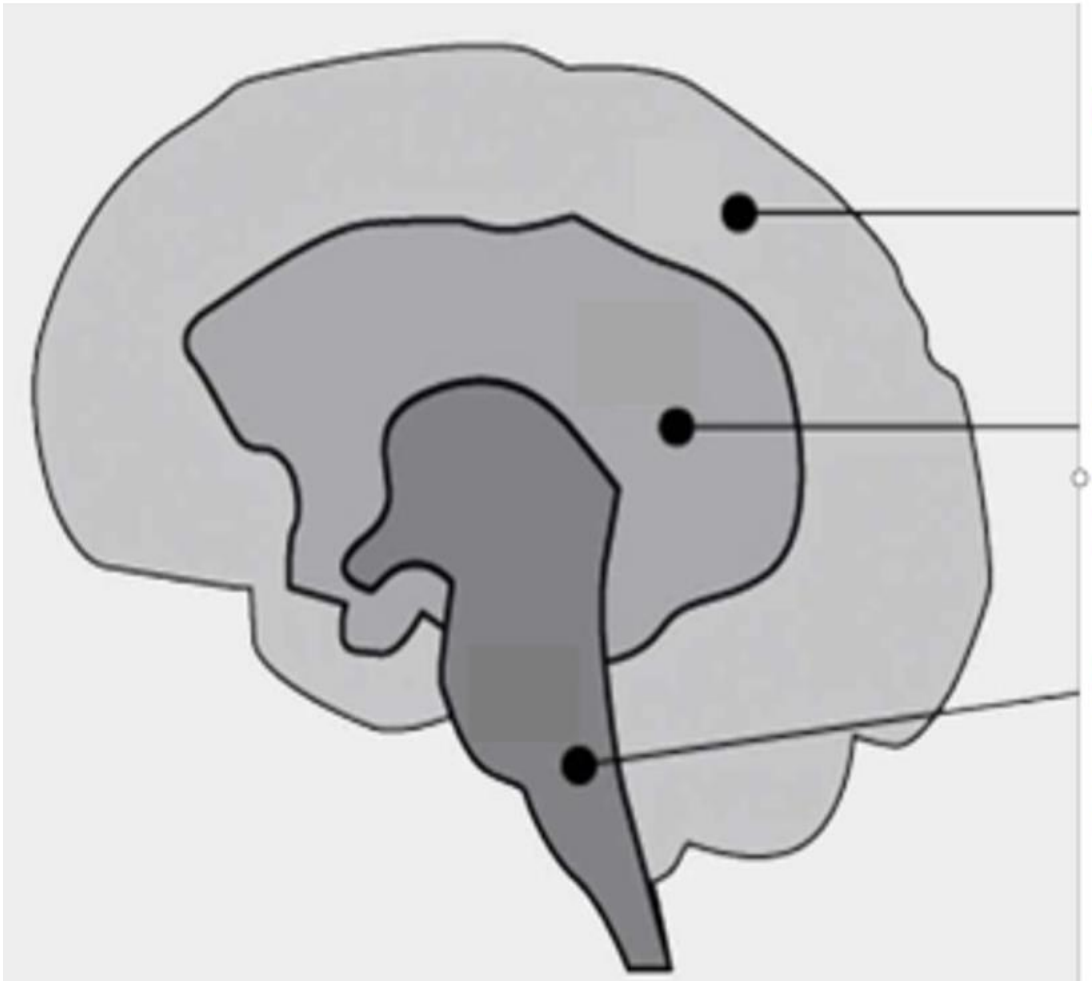
1. Animal trainers at work for the movie 'Babe' https://www.youtube.com/watch?v=dKfMG2d_qT8
2. Knolle, S. (2021). All about the pig in the new Nicolas Cage movie. *Moviepaws*, July 17. https://moviepaws.com/2021/07/17/all-about-the-pig-in-the-new-nicolas-cage movie/#:~:text=The%20pig%20wasn't%20trained,told%20the%20New%20York%20Times
3. That'll Do Pig - Babe (9/9) Movie Clip https://www.youtube.com/watch?v=0zHmeTeLgMY

“motive”

“[it} is more skills focused than theory focused, … The *4IR needs more skills taught to learners* and not just a change in focus of subjects that are already offered” (Motshekga, 2020).



The cognitive construction level of ***skill*** (knowing)



individual & **cultural**

neocortex
cognitive constructions
(knowledge)

limbic brain
feelings
(motives)

crocodile brain
emotions / reflexes
(instincts)

“knowledge”

A skill is emergent from a deeper knowledge system and associated practice:

- Skilled tool use - generated by a neural network of tacit procedural and propositional knowledge, that acquires automaticity with sustained practice.
- Thinking skills - generated by cognitive processes and executive control functions of the brain working together to encode novel information for future use.
- Critical thinking skills (problem-solving, reflexive social collaboration, etc.) – all of which connote ‘authentic practice in real world contexts’ – entail deliberate acts of cognition generated from within deep, complex, internalized knowledge systems.
- Skilled judgments of scientists are ‘paradigmatic’ or ‘problematic’, i.e. situated in a generative knowledge programme: research techniques, rules of evidence, objects of study.

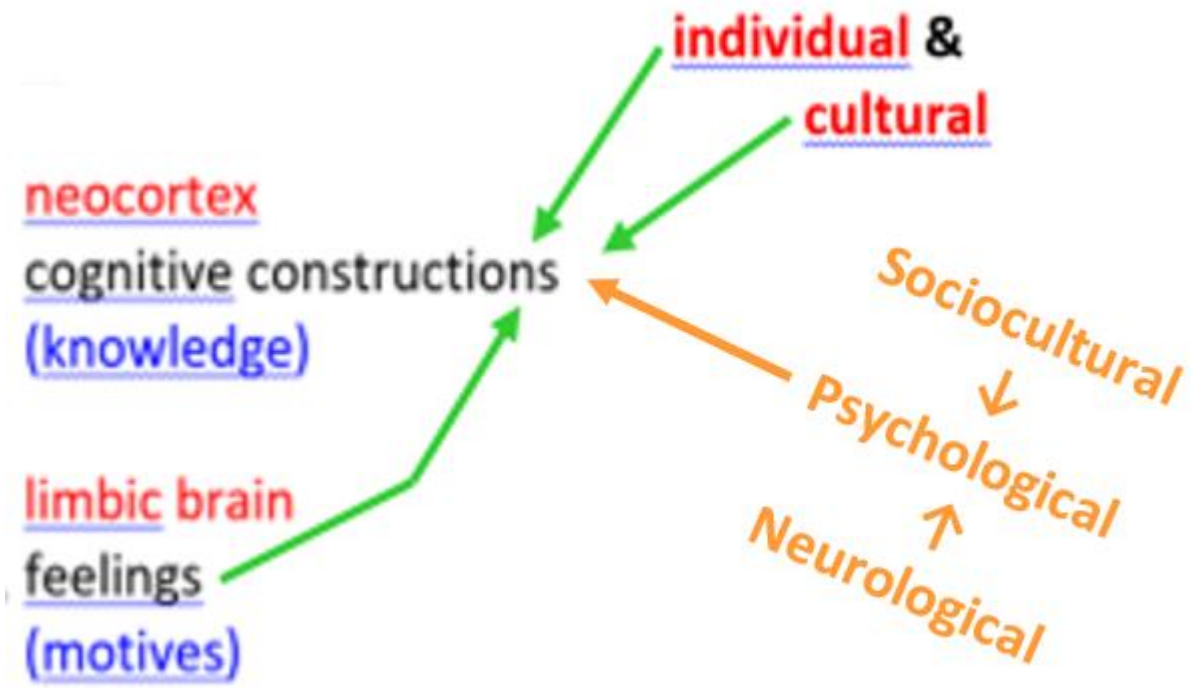
Skills are anchored in meaningful knowledge contexts

Therefore, ***AVOID!***

- BF Skinner's notion that skills are "positioned in the atomistic, manipulable, immediate environment of the learner… The whole process of becoming competent in any field must be divided into a very large number of very small steps". (Skinner, 1954:94);

- Gagné's view that educational assessment should be pinned to operational definitions of discrete performances (Gagné, 1965: 243-244);
- The Competency-Based Training movement in TVET;
- The '12 critical cross field outcomes and 66 specific outcomes' of *Curriculum 2005*;
- Trilling and Fadal's (2009) *21st Century Skills*: narrows our conception to procedural skills required to work the digitized ICT economy.
- WEF *skill sets*.

Skills are emergent psychological properties



Teaching robotics = teaching AI

Robots will never be able to think like human beings.

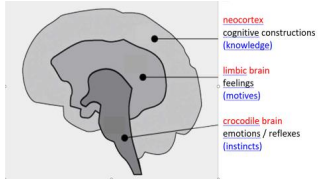
- Robots are not capable of “common sense”.

  objects fall downwards, water flows, if something is hidden behind something else it’s still there, every human has a mother; a cup of coffee gets cooler, Mzansi taxi driver moves
  1984 → Lenat’s “CYC Project” – write symbolic AI rules for all common sense knowledge – not even 5% done. Probably impossible.

  Melanie Mitchell. *Artificial Intelligence: A Guide for Thinking Humans* (2019).

- Humans are “feeling machines who think”

  “There is no such thing as a mind without emotion” - Damasio



- The “Chinese room” experiment – robots cannot have consciousness

Antonio Damasio, Portuguese neuroscientist & neuropsychologist

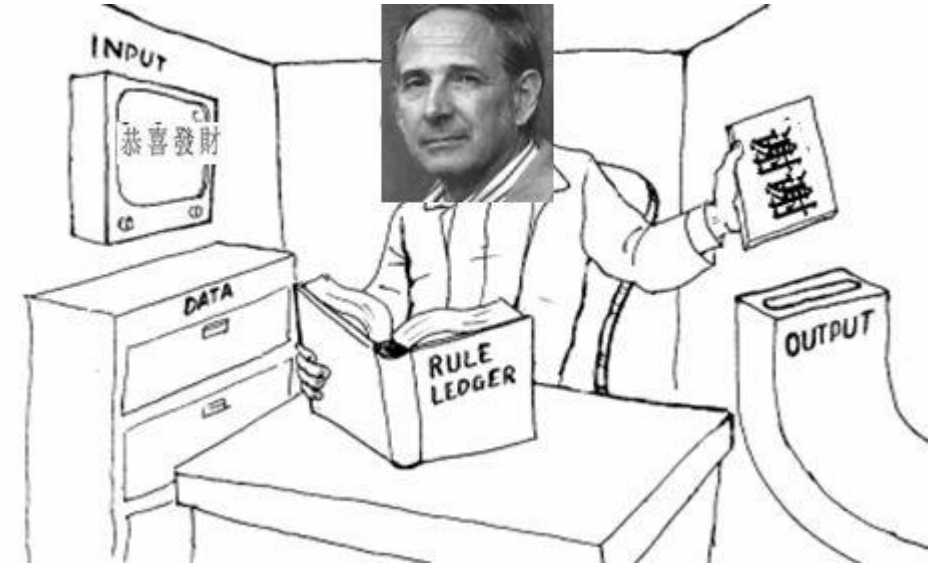
"Let's be clear on this, we always emote. We are emoting all the time. There is no such thing as a mind without emotion."

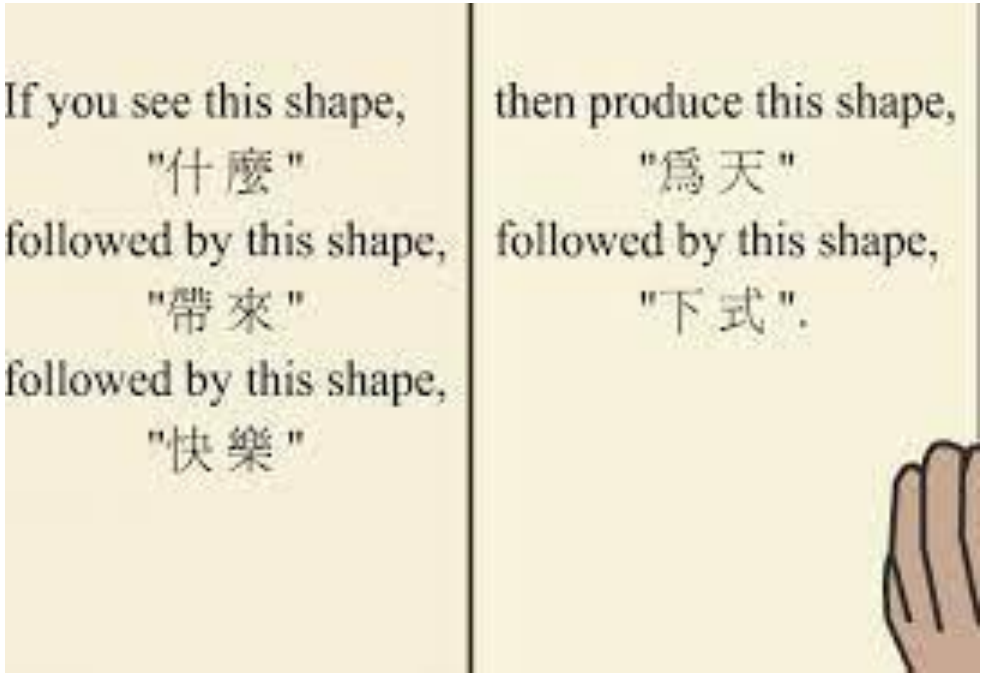
"We are not necessarily thinking machines that think, we are feeling machines that think"

"The fact that we are capable of thinking, reasoning, and having this incredible construction at a very high level of the mind does not mean we have forgotten about emotions, the emotons are still here, and the feelings are still here, and they accompany everything we do."

https://www.youtube.com/watch?v=Aw2yaozi0Gg

AI Chinese Room experiment





Strong AI

Narrow AI

More amendments to CAPS on teaching robotics

FP – ‘robotic skills’ acquired vicariously in play using digital devices, robot games and digital toys.

Is a doll alive?

INTERSEN – ‘robotic skills’ - ‘output devices’ (diode lights, buzzers, etc.) and ‘input devices’ (buttons, sensors, etc.) in robots, and ‘automation’; and “coding skills’ - ‘number variables’, ‘text variables’.

1960s

1973 2000-2018

VS

SP – (i) generic skills – problem solving, critical thinking, collaboration, creativity – related entirely to digital technology (ii) specific coding skills, including of simple microcontrollers in robots.

KNOWLEDGE → SKILLS

Thank you.

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- Moll. I. (2022). The curious case of blockchain in the dubious queue to prop up 'fourth industrial revolution' mumbo jumbo. *Daily Maverick*, 2 February.