Fostering Metacognitive Awareness in Pre-Service Teachers

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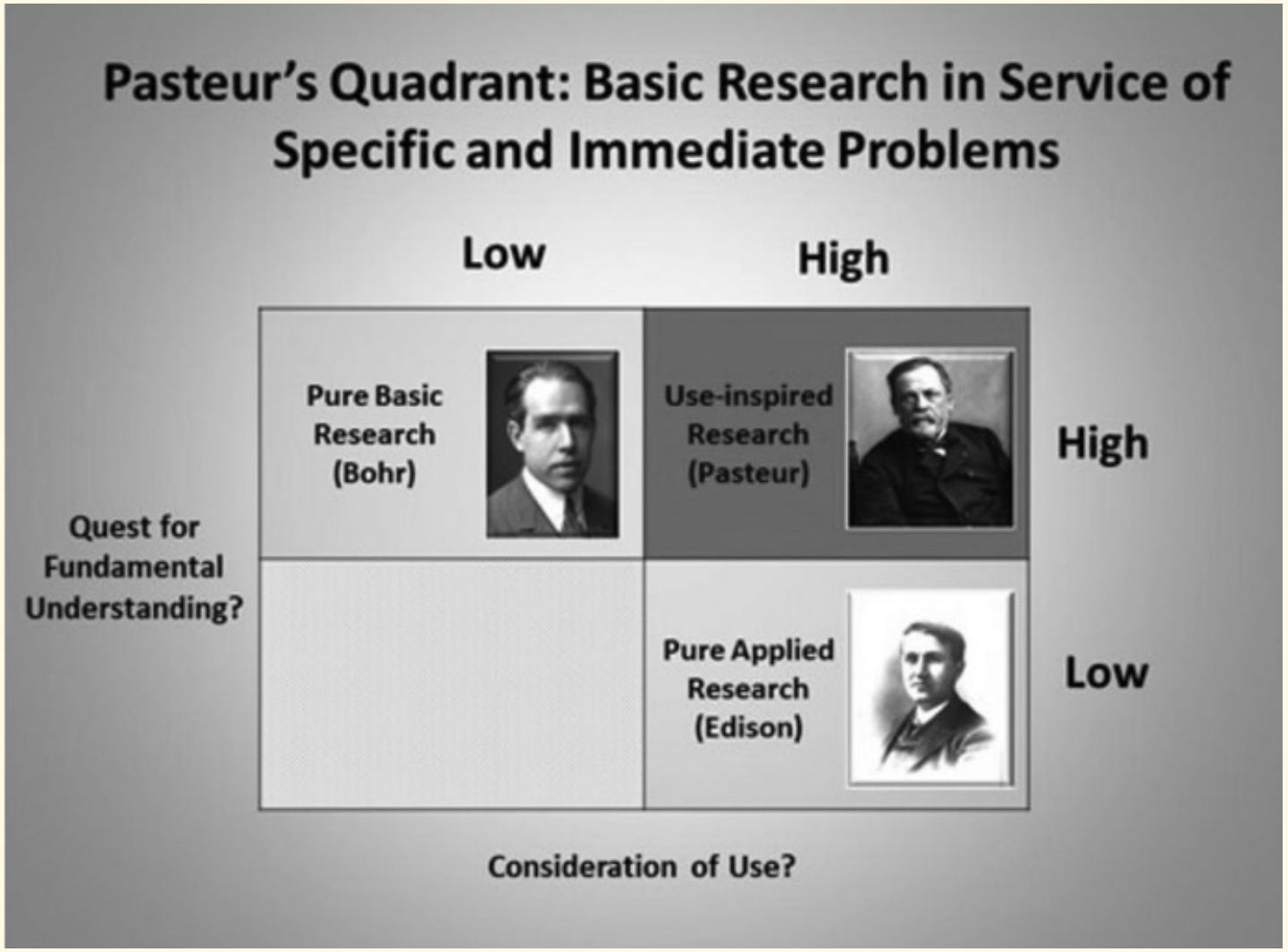
Close-to-practice research

ITE Curriculum, Pedagogy and Assessment Research Group

- reciprocating inter-relationships between curriculum, pedagogy and assessment in the development of education professionals, and we research at the intersections of these complex dynamics
- rooted in the singular nature of student teachers' dual experiences as both learners and (future) teachers
- diversity of theoretical approaches within education
- methodologies ranging from case studies, action research, autoethnography and phenomenology to quasi-experimentation

Pasteur’s Quadrant



Pasteur's Quadrant. Adapted from Stokes (1997:73) Quadrant Model of Scientific Research (Powell et al, 2016)

Disciplinary identity and belonging

- Link of disciplinary identity with attainment (Vakil, 2020)
- Dual identity (Elbra-Ramsay, 2021; Zhan, 2023)
- Transdisciplinary threshold crossings (Masika, 2024)
- Student teachers have to see themselves as educators
- Science teacher identity strongly influenced by the science practice they perceive in school

Tensions at primary/secondary science

- Disconnect
- Lack of confidence
- Lack of subject knowledge
- Impoverishment as a ‘core’ subject

- Year-on-year failure to meet recruitment targets
- 1/3 science teachers planning to leave in 5 years
- Loss of science technicians
- overreliance on testing for external accountability at key stage 4 (GCSE level) and post 16 (A levels and equivalents), which fosters a culture of ‘teach to the test’ (ASE, 2024)

ASE election ‘asks’

1. National review of the vision for science education
2. Reform of the science education curriculum and assessment

Whilst curriculum reform is taking place in Wales and Scotland, the national curriculum in England has not been reviewed over the last ten years and is outdated in many respects. It is content heavy, prioritises rote memorisation over critical thinking, problem solving and practical skills and discourages cross-disciplinary exploration.

ASE, 2024

The Statement

Initial Teacher Training and Early Career Framework [ICTECF]:

Learn that : Explicitly teaching pupils metacognitive strategies linked to subject knowledge, including how to plan, monitor and evaluate, supports independence and academic success.

[informed principally by the EEF (2018) Guidance Report & Evidence Review (2020)]

The Sell

Metacognition, the ability to reflect on and regulate one's own thinking processes, is argued to play a pivotal role in both effective teaching and lifelong learning, with suggestions explicit practice is beneficial for disadvantaged pupils

(EEF Toolkit + 7 months)

The Problem

KB: So, at the start of the year, I stood there in that in that lecture theatre, and I said, ‘who knows what metacognition is?’ And I think about 10 people put their hands up.

Billy: Yeah, I was not one of those 10.

KB: So, it was never anything that was explicitly talked about with you when you were at school?

Billy: No, it was never mentioned…cognition... Yeah. From my previous time in sixth form because I did psychology. So, we said the word ‘cognition’ quite a lot. But metacognition was never brought up as that phrase. The closest that I would say I got to that phrase was cognitive *load*, because that was brought of my previous workplace that was like some training we did. But metacognition…. I don't remember being brought up.

The Reality

Student teachers often commence Initial Teacher Education without a robust understanding of metacognitive strategies and their application in educational contexts.

They are often therefore ill-prepared to explicitly model and teach it, without receiving instruction and practise themselves.

Metacognitive knowledge and self-regulation do not happen by osmosis…why do teacher education programmes behave as if they do?

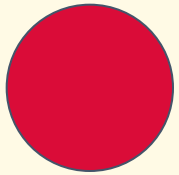
The plan

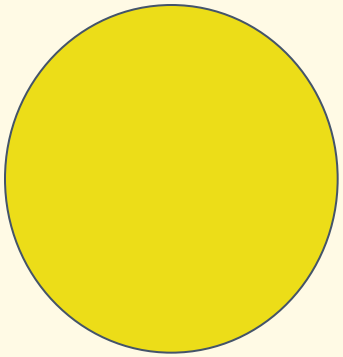
Direct approach - explicit instruction and 'teacher' modelling ('plan, monitor, evaluate') [EEF]

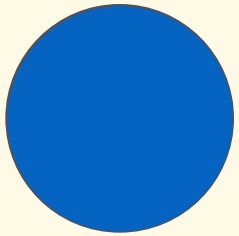
Indirect approach - creating a conducive learning environment, with guided practice, including dialogue and (scaffolded) enquiry

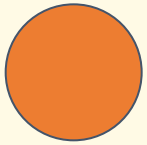
Blend - explicit teaching of strategies and teacher modelling, practise through verbalising, and more open-ended enquiry work during which prompts and scaffolds may be faded to promote more student agency and autonomy.

The disrupt









Which ball is the bounciest?

Pointing

Prange's operational model of education (2012, Biesta, 2022)

'Zeigen' ('pointing' and 'showing')

What the 'teaching' is about/operationalised.

"What is distinctive about pointing is its 'double character', as the one pointing is not just pointing *at something* but is, in the act of pointing, referring *to someone*. The 'Look there!' of pointing always means '*You* look there!,' so we might say" (Biesta, 2022:20)

The prompt


Adapt...to adjust to
Compromise...to reach an agreement by give and take
Explore...to look into closely, to examine
Interpret...to explain the meaning of
Prioritise...to organise points/factors in order of importance
Analyse...to break things down to see how something works
Decipher...to discover the meaning of something hidden
Generalise...to apply a wide meaning to different situations
Manage...to bring about or to exert control over
Process...perform a series of actions to bring about a result
Apply...to put to a relevant use
Define...to describe the meaning of something
Generate...to make, to bring into being
Manipulate...to move things around with skill
Question...to ask something to find out an answer
Characterise...to describe using the distinctive features of
Develop...to extend from a simple to a more advanced state
THINKING and TALKING about your THINKING
Model...to create a description that explains how something works
Reconstruct...to rebuild or reassemble in a different way
Collaborate...to work together equally
Differentiate...to recognise differences between
Negotiate...to discuss in order to reach agreement
Reflect...to think about what you did and how you did it
Combine...to join together
Evaluate...to examine evidence and form an opinion/conclusion
Hypothesise...to float an idea or propose an explanation
Organise...to give structure to
Summarise...to make a shorter version of something
Communicate...give information, to make something known
Examine...to investigate or consider critically
Identify...to recognise something by analysis
Plan...to devise a scheme to accomplish a purpose
Synthesise...to bring things together to make something new
Compare...to look for similarities and differences
Explain...to say why
Implement...to put into practice
Predict...to say what might happen in the future
Visualise...to see in your mind's eye

The study

Semi-longitudinal [2 semesters]

Pre- and post-intervention surveys (n=131)

12 science workshops with blended approach

- Metacognitive knowledge
- Skills development
- Debriefing and discussion
- Plenary reflective activities (Menti, Gimme 5, Padlet)

Interview f2f + Teams/Focus group/Written response

The learning

Learning gains: It sounds a bit egotistical, but I know I've worked hard in some regards and that makes me feel really good. I know that I've worked hard because I know the learning I've done if that makes sense? So, I do think it is actually quite important to bring up metacognition. It made me recognise where I've come from this year.

When you look back at yourself, like when I was at sixth form or at the beginning of Uni, I'm just like 'why wasn't I just doing this already? I can open up a book or look at some planning and I know exactly what it means. I'm like, feel very cemented where I am now. I feel like I've got a really strong foundation.

It's made me realise how much feedback and feedforward we get as student teachers.

I liked doing the reading because it kind of gave me insight into what we were going to do. And it sounds kind of big headed, but I I love answering questions. I *like* being more knowledgeable.

Removing distractions: So, my computer is my big distraction. I'm a big nerd. I love my computer to play games, so I don't do work on my computer. I take myself to the library and removing [sic] myself physically from my bedroom, so I don't game, I take my laptop to work on cos I don't use that for games.

Time to focus: Work in the library with Hannah. Hannah's a really hard worker so I find it really easy to work around her because she's focused and I'm like, aah, I can be focused, and I find that really helpful to work with others as well who are on the same wavelength as me.

Looking forward: And it's kind of got me quite geared up for year two.

Give me 5

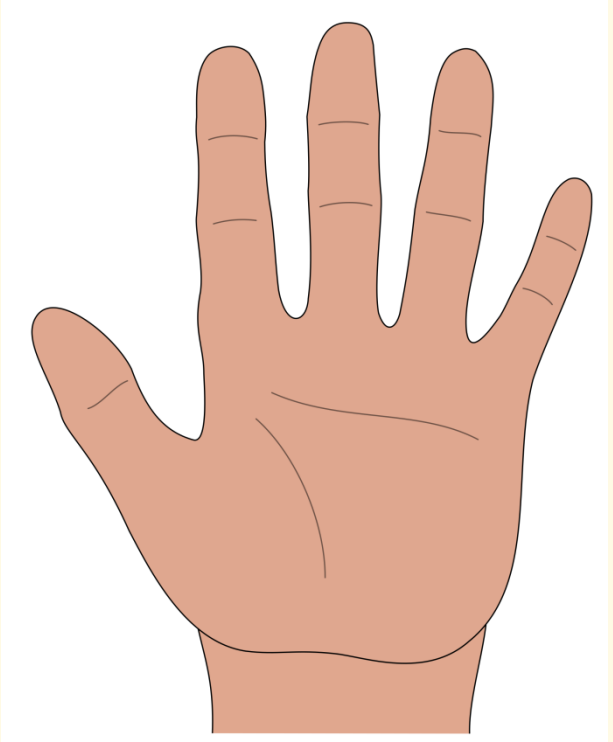
Thumbs up: What new science have you learnt?

Pointing finger: What skills have you used today?

Middle Finger: How did modelling help you learn something?

Ring Finger: How did you show commitment to today's learning? Who did you help today?

Pinkie Promise: What will you make sure you remember from today's lesson?



First finger – skills

Modelling
****

Reflecting ****

Teamwork ****
****

collaboration **********

Communication **********

Negotiating agreement *******

Organisation ** ** (planning)
****

Implementing (making the model)
*** generating ****

Visualisation, using analogies
****

Evaluating (models) ***

Creativity (making models)
****

Adapting ****

Problem solving

Decision making

Applying ****

Patience **

observation

listening

A pedagogy of attention

The process of attention in itself is of considerably greater value than whatever it is that is being attended to:

'Although people seem to be unaware of it today, the development of the faculty of attention forms the real object and almost the sole interest of studies. Most school tasks have a certain intrinsic interest as well, but such an interest is secondary. All tasks which really call upon the power of attention are interesting for the same reason and to an almost equal degree.'

Weil (2021:62)

Candle Race 1

John noticed that when Jo lit a candle in a small lantern it often flickered and went out.

When Sue lit the candle in a much larger lantern it usually burned brighter and for much longer.

Jo said, “I bet a candle with more air around it will burn better than one in a small space’

Design an experiment to find out if this is true.

Adapted from McGregor (2008)

Candle Race 2 (enquiry, plus)

Design an experiment to find out if this is true.

Equipment you might use:

Think carefully about the following before you start to carry out the experiment.

- How can you accurately measure how long the flames burn in different sized jars?
- How can you make sure that your tests are fair?
- How will you present your results?
- How many times do you need to repeat the experiment so you know your results will be reliable?
- What do your results mean?

Candle Race 3 (enquiry, plus+)

This is an investigation to find out if the amount of air available in the lantern affects how long remains alight.

You will need:

3 candles of the same size

Bunsen burner

Small jar, Medium size jar, Large jar

spill

safety mat

goggles

stop clock

What to do:

Light the Bunsen burner (remember you must have your goggles on)

Set out each of the candles, with a jar close by, ready to light the spill.

Light each candle.

Start the stop clock at the same time place the jars over each candle as in the diagram above.

Record how long each flame burns for and fill in the results below.

After each try turn the jars upside down several times before repeating the experiment.

Can you explain your findings?

Time that candle Burns for	Small jar	Medium jar	Large jar
1st try			
2nd try			
3rd try			
Average of all three tries:			

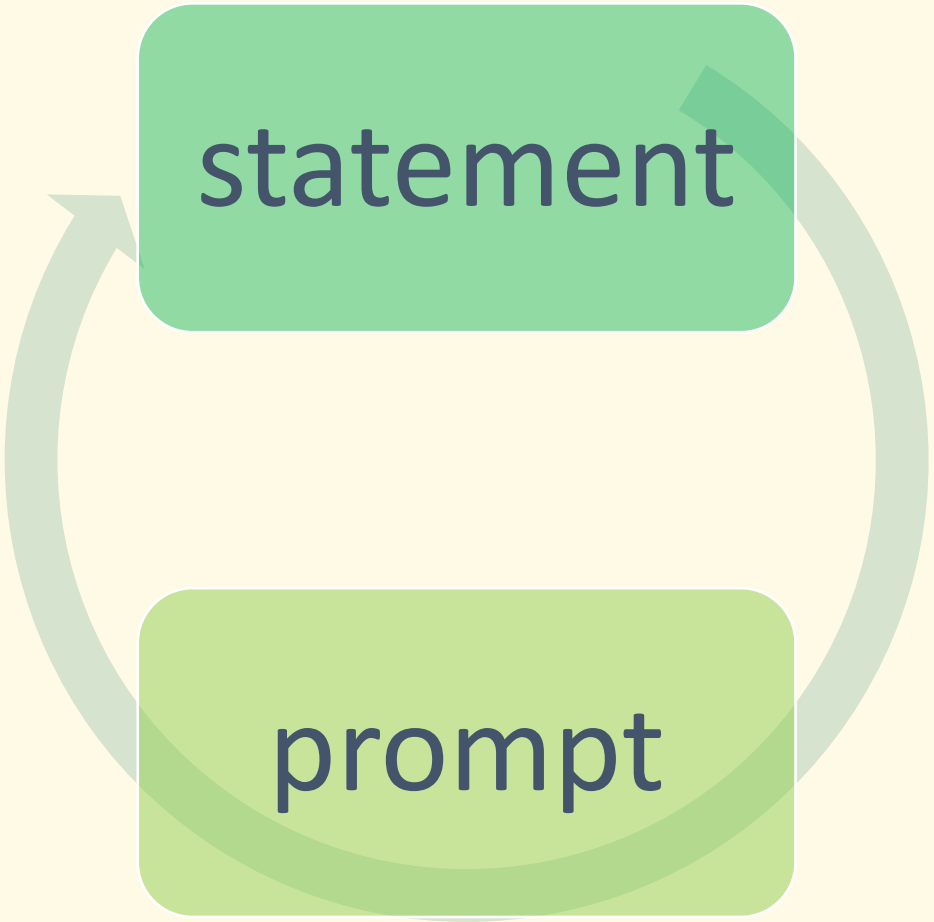
The role of feedback

Feedback does not take place in a vacuum

‘Feedback can only build on something; it is of little use when there is no initial learning or surface information’ (Hattie & Timperley, 2007)

Feedback more likely to move learning forward			Less likely
Task  *Feedback focused on improving a specific piece of work or specific type of task. It can comment on whether an answer is correct or incorrect, can give a grade, and will offer specific advice on how to improve learning.*	**Subject**  *Feedback targets the underlying processes in a task, which are used across a subject. The feedback can, therefore, be applied in other subject tasks.*	**Self-regulation strategies**  *Feedback is focused on the learner's own self-regulation. It is usually provided as prompts and cues—and aims to improve the learner's own ability to plan, monitor, and evaluate their learning.*	**Personal**  *About the person. It may imply that pupils have an innate ability (or lack of) and is often very general and lacking in information.*

Process and SR Feedback – and feedforward



Process and Self-regulation *statements*

Office on the web Frame

You interpreted/explained that well
You applied your knowledge well there
That was a good analysis
That was a good strategy to use
Clear summary of the method
You communicated well with each other
Excellent modelling of skills there
That was good effort there
I liked the way you kept on at that
You worked really hard at that…
I was impressed with how hard you worked
You've put a lot of thought into how that would….
Good reflections on your learning!
You really persevered with …
Well done for carrying on when you found it challenging

Process and Self-regulation *prompts*

What would happen if…?
What was your starting point?
How could you break that down?
What else could you add?
How could you develop this further?
What more would you like to find out?
What does this lead onto?
How did you do it/create it?
How do you know that?
What kind of data would support…?
What is this an example of?
What is another way to explain…?
Tell me more about…
What were the reasons you chose to do it that way?
Did you change anything?
Why is that important?
How does…affect…?

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Ramprasad's feedback 'loop' reimagined to 'close the gap' (Bloom, 2020)

The next step

After this analysis…

Development of a new module through revalidation ‘Professional and Academic skills’

- Independence and autonomy
- Agency and self-regulation
- Thinking skills
- Learning journal
- Metacognitive summative assessment 2.06

Ethical approval for 24/25 enlarged study.

Metacognition ITAP

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