'*STEMifying*' Science

Exploring the Challenges & Opportunities

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STEM Education Policy in Ireland

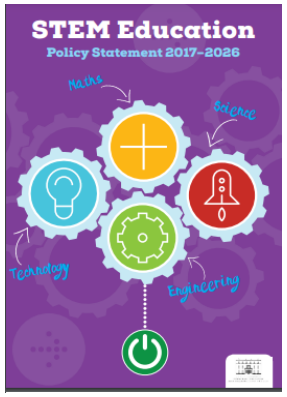
Nov 2016

Report on STEM Education

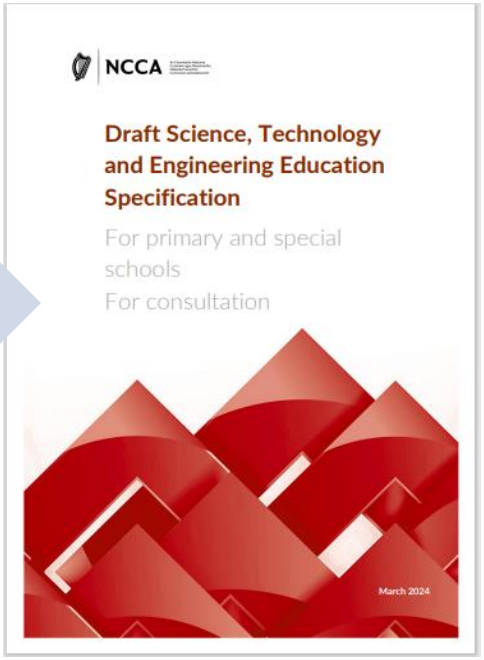
2017

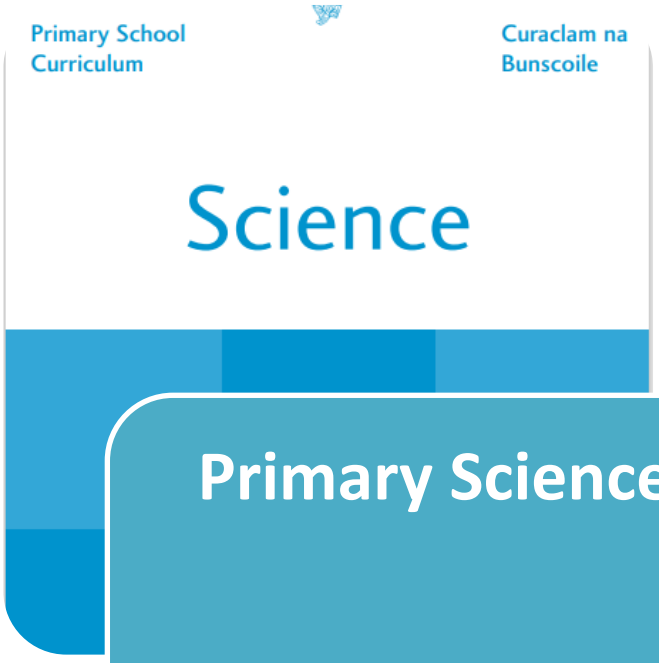
Consultation Report

Implementation Plan 2017-2019



Policy Statement 2017-2026





Primary Science

Social, Environmental & Scientific Education

(1999)

Science Technology & Engineering

Draft

(2024)

Challenges in Primary Science

- Pre-service teachers' low subject content knowledge (SCK)
- Pre-service teachers’ poor Pedagogical Content Knowledge (PCK)

- In-service teachers' lack of confidence in teaching science
- Limited development of children's process and thinking skills
- Reliance on text-books
- Limited evidence of child-centred pedagogies

NCCA

Draft Science, Technology and Engineering Education Specification

For primary and special schools

For consultation

March 2024

Future of Science

Potential Risks
'*STEMifying*' Science

Multi-dimensional Project-based learning

Dilution of Science Content Knowledge

Lack of recognition of science disciplines

Limited assessment of Science learning

Hands-On Minds-On (which concept?)

Opportunities
'STEMifying' Science

Early years interest in STEM

Increasing accessibility to Science

Project-Based Learning & Contextual, Everyday applications

Constructivist and learner-centered pedagogies

Agency in curricular integration

Teachers' perceptions of STEM

*…**it transcends subjects and content knowledge**…its very much in line with **twenty-first century methodologies…**it privileges first and foremost, the whole learner-centred skills-based learning…the skills are transferable, they're not unique to any one particular subject, but STEM is a unifier across the disciplines…*

***…Its collaboration, its planning, its organisation, its determination, communication and oral language is a huge part of STEM…**each group delivers their investigations afterwards… so each person in the group has to talk and explain what they did, what they changed and what they would do differently if they were to do it again* (Teacher)

*I think there is a notion out there that it might be the 12th subject, **it's another new subject, but it's not. To me it's a way of teaching.** For me, I'm beating the drum all the time…allowing for inquiry, creativity, problem solving and the whole growth mindset* (Teacher)

STEM, as step too far?

I think there's a place for STEM but you have to do the content, like the maths. If you're only touching bits and pieces, just randomly as they come across them in a STEM activity, that's not going to work. ***So, I still think they [learners] need the core. But then if they could build STEM in, maybe once a week…they could use concepts that they learned.***

'Where does it belong?', 'What should it replace?', 'Where should the time come from?'

Effective Model of STEM Education PD

- Peer collaboration, support networks

(Baker-Doyle and Yoon 2011, Kilpatrick & Fraser 2019)

- Needs-led, placing the teacher in the role of learner

(Kilpatrick and Fraser's 2019)

- Modelling by the PD facilitator

(Parker et al.'s 2015)

- Engaging in integrated STEM first as a learner

(Estapa & Tank, 2017; Nesmith and Cooper, 2019)

- Extended, multi-year STEM PD

(Brown and Bogiages 2019)

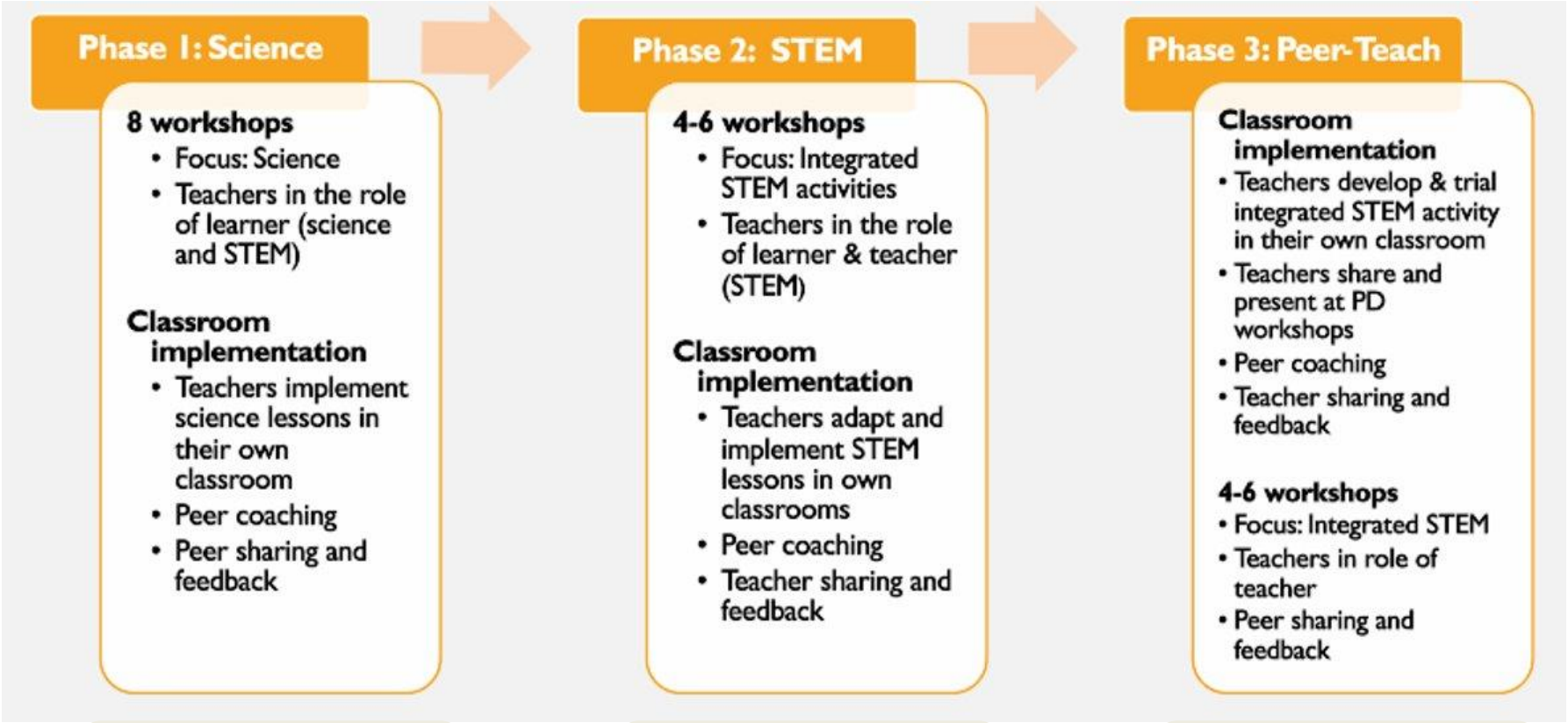
- Situating PD within teachers' own school

(Shernof et al., 2017)

- Peer coaching approach, supported by a mentor

(Owens et al., 2018; Parker et al., 2015; Showers & Joyce, 1996, Cotabish et al., 2011).

STEM Professional Development



Phase 1

- Developing Teacher Efficacy in Science

Phase 2

- Supporting Teacher efficacy in STEM

Phase 3

- Enabling Teacher efficacy in STEM

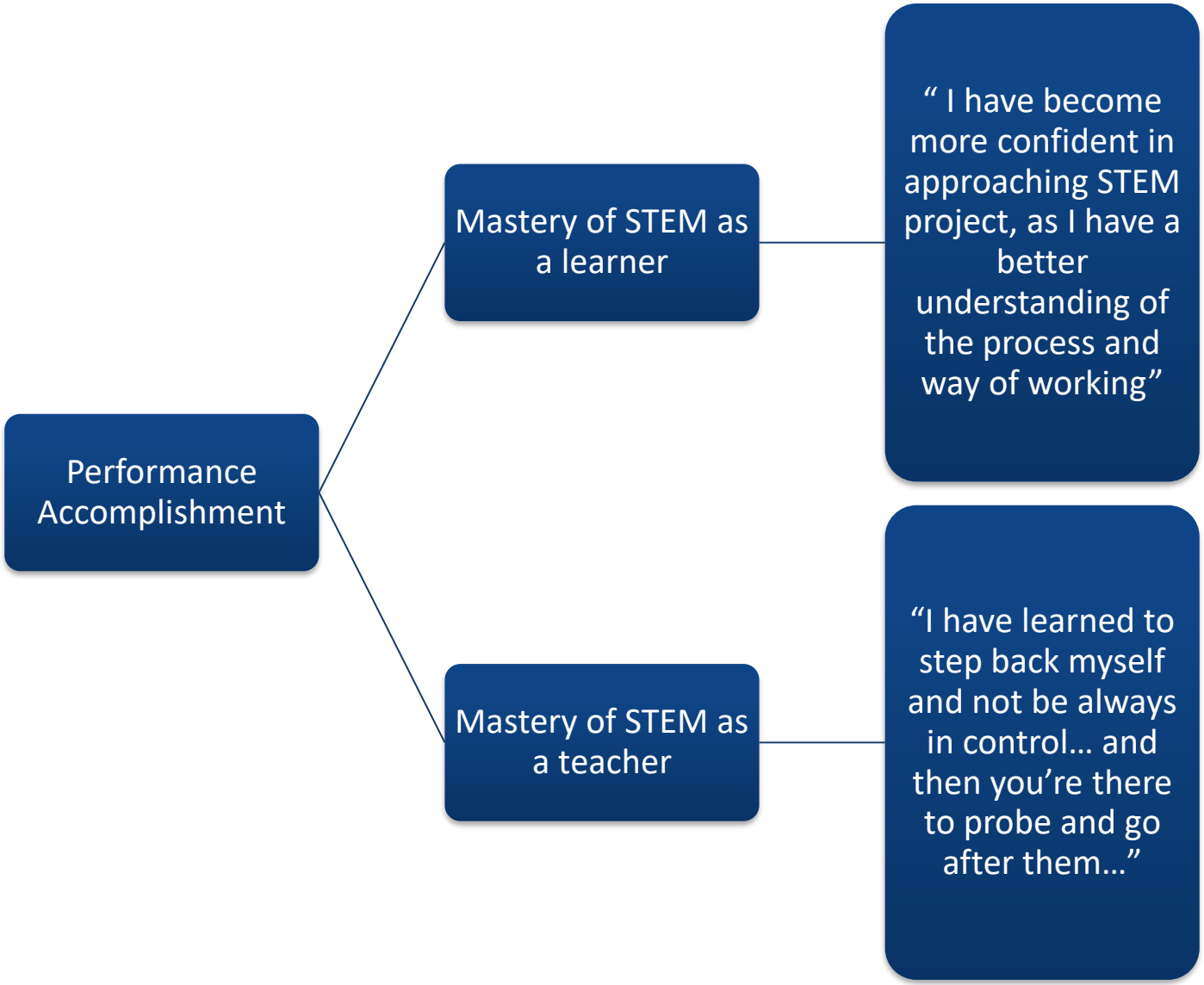
N=60 primary teacher participants
3 school years, longitudinal

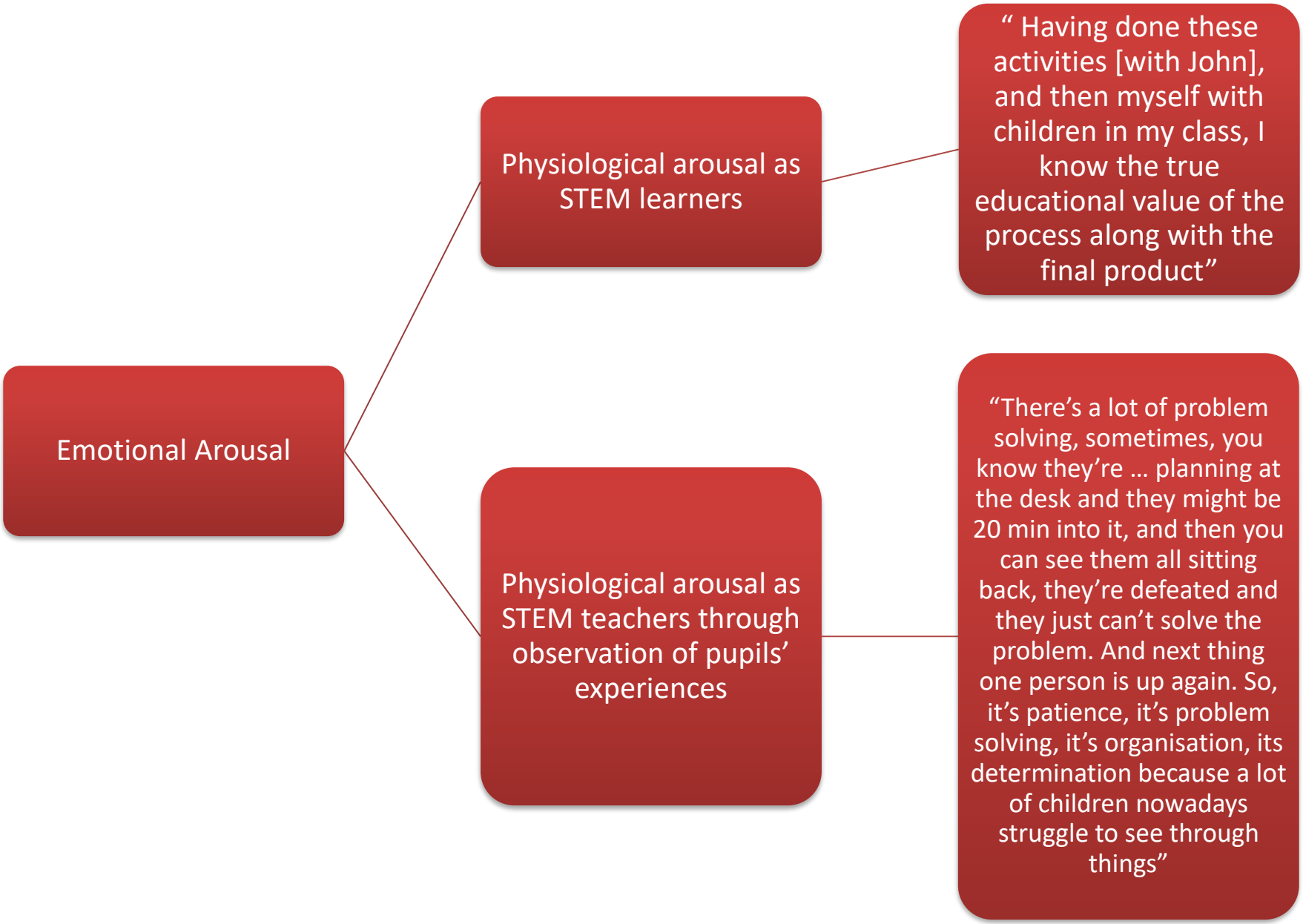
Sources of Self-Efficacy in STEM Education

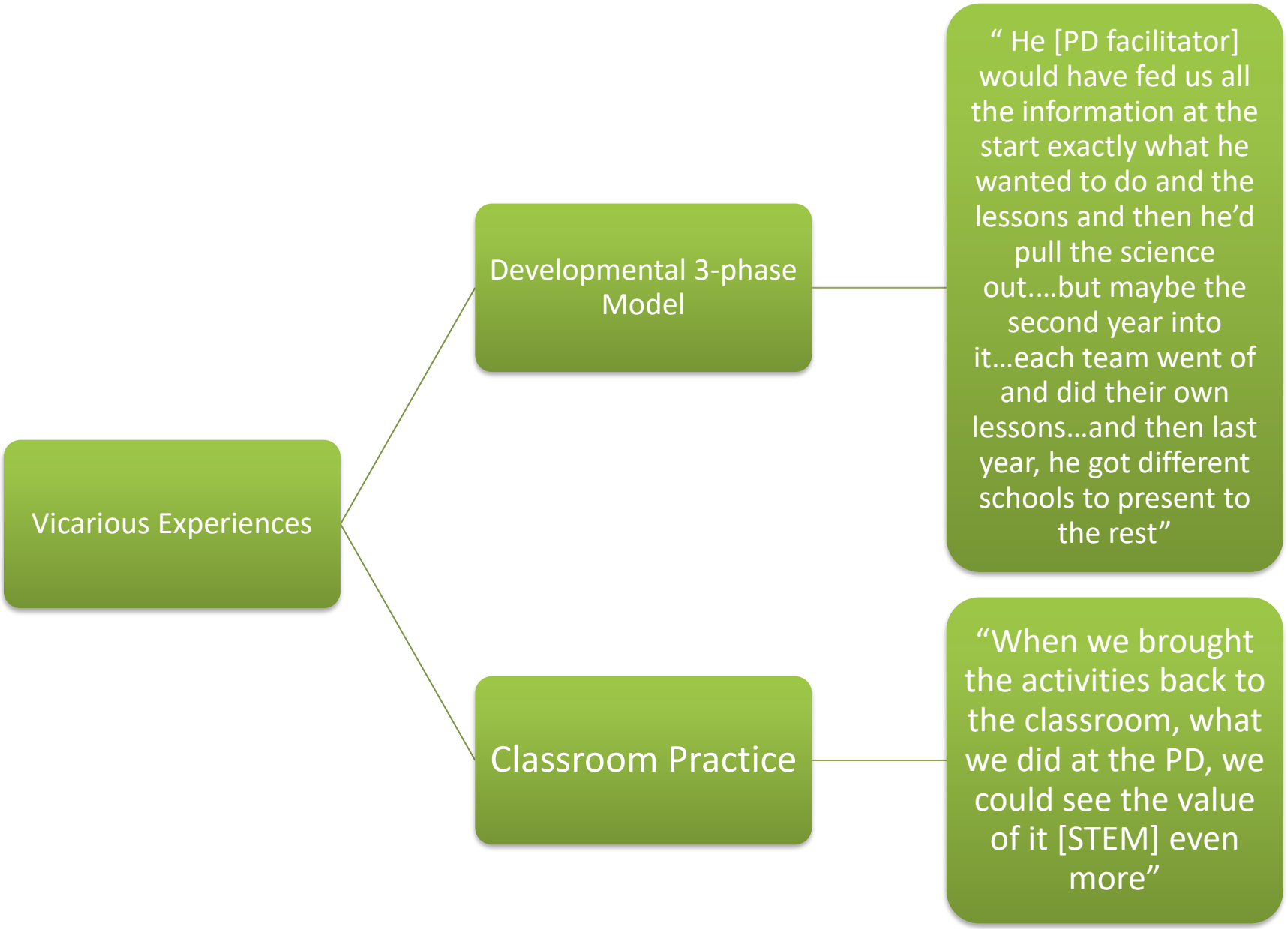
One's belief in his or her ability to produce a desired outcome, (Bandura, 1977)

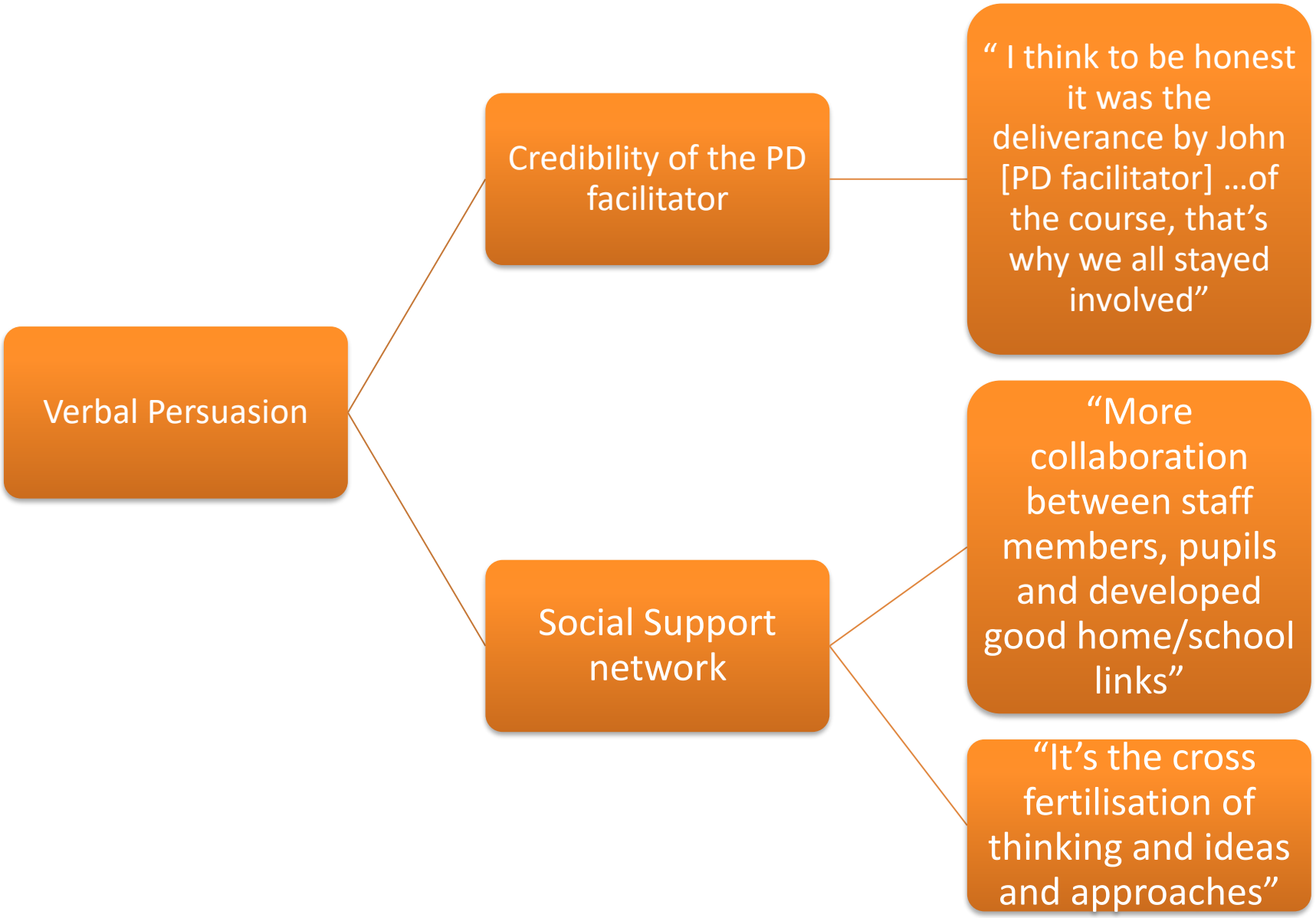
- **Performance accomplishment**
- **Vicarious experiences**
- **Verbal persuasion**
- **Emotional arousal**

N=17 participants (teachers, school leaders, PD facilitator)
Pre & post surveys
Individual teacher interviews


Performance Accomplishment
Mastery of STEM as a learner
" I have become more confident in approaching STEM project, as I have a better understanding of the process and way of working"
Mastery of STEM as a teacher
"I have learned to step back myself and not be always in control… and then you're there to probe and go after them…"


Emotional Arousal
Physiological arousal as STEM learners
" Having done these activities [with John], and then myself with children in my class, I know the true educational value of the process along with the final product"
Physiological arousal as STEM teachers through observation of pupils' experiences
"There's a lot of problem solving, sometimes, you know they're … planning at the desk and they might be 20 min into it, and then you can see them all sitting back, they're defeated and they just can't solve the problem. And next thing one person is up again. So, it's patience, it's problem solving, it's organisation, its determination because a lot of children nowadays struggle to see through things"

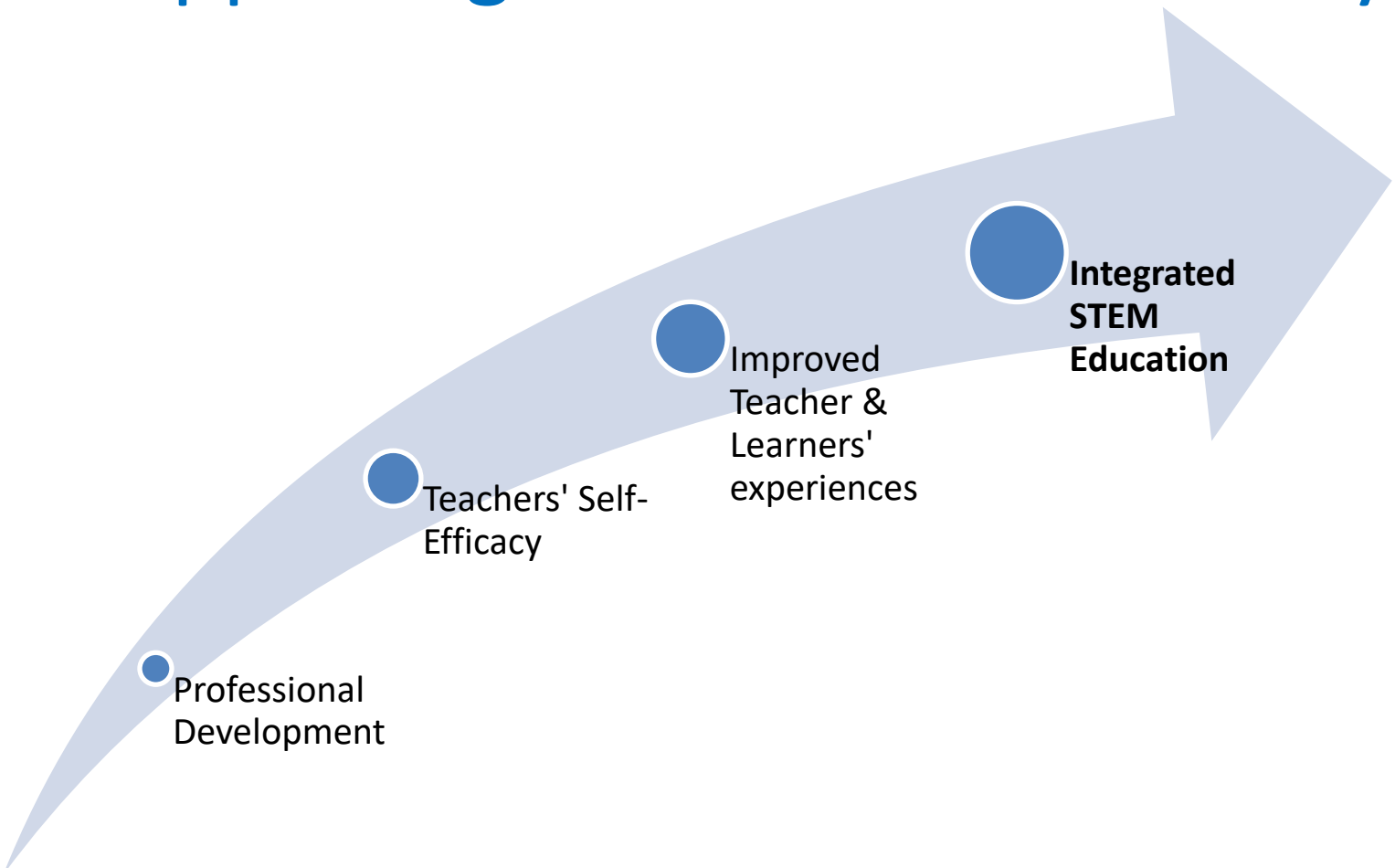

Vicarious Experiences
Developmental 3-phase Model
" He [PD facilitator] would have fed us all the information at the start exactly what he wanted to do and the lessons and then he'd pull the science out....but maybe the second year into it...each team went of and did their own lessons...and then last year, he got different schools to present to the rest"
Classroom Practice
"When we brought the activities back to the classroom, what we did at the PD, we could see the value of it [STEM] even more"


Verbal Persuasion
Credibility of the PD facilitator
" I think to be honest it was the deliverance by John [PD facilitator] …of the course, that's why we all stayed involved"
Social Support network
"More collaboration between staff members, pupils and developed good home/school links"
"It's the cross fertilisation of thinking and ideas and approaches"

STEMifying Science

Through Incremental Change

Supporting Teachers' self-efficacy



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