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Argumentation-in-practice: a case study of using action research to develop argumentation practices in secondary science

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Argumentation

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- Is a core feature of the scientific practice as scientists often engage in arguments about which data to collect and how to interpret them (Bricker & Bell, 2008; Menz, 2014)
- Is 'a social process of constructing, supporting, and critiquing claims for the purpose of developing shared knowledge' (Menz, 2014)
- in science education can take the form of *dialogic interaction* (Driver, Newton & Osborne, 2000)

Discourse intensive – requires teachers to develop specific pedagogical discourse practices

Professional Development on Argumentation

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Developing teachers' dialogic argumentation practices – Simon, Erduran & Osborne (2006)

- talking and listening; justifying with evidence; constructing arguments; evaluating arguments; counter-arguing/debating; and, reflecting on argument process

Argumentation PCK - McNeill and Knight (2013)

- teachers developed their knowledge of the structural components of argumentation improving their ability to distinguish various parts of arguments
- similar changes in their classroom talk were not identified

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Research Question

Does an action research approach to professional development of argumentation practices facilitate change in a teacher's instructional practice of argumentation?

Methodology

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qualitative, exploratory case study (Yin, 2013)

PD incorporates aspects of action research, defined as 'an action-reflection cycle of planning, acting, observing and reflecting' of own practices (McNiff, 2013, p.56)

one middle school teacher, had 5 years of teaching experience; wanted to make her lessons more interesting and engaging for her students

8-month duration (Dec 2013 – Jul 2014) and data collected included lesson observations, reflective discussions and interviews, field notes, lesson plans and resources

narrative analysis and thematic analysis approaches used (Alvesson & Sköldberg, 2009)

Claim – Evidence – Reasoning framework

(McNeill & Krajcik, 2012)

Dialogic teaching

(Alexander, 2008)

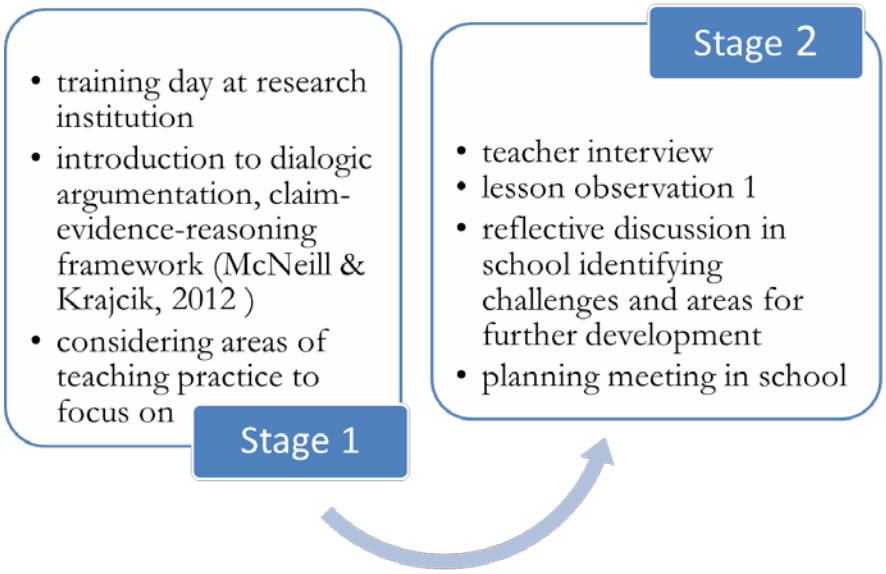
Epistemic practices

Constructing – Justifying – Evaluating

(Kelly, 2008; Christodoulou & Osborne, 2014)

- training day at research institution
- introduction to dialogic argumentation, claim-evidence-reasoning framework (McNeill & Krajcik, 2012)
- considering areas of teaching practice to focus on

Stage 1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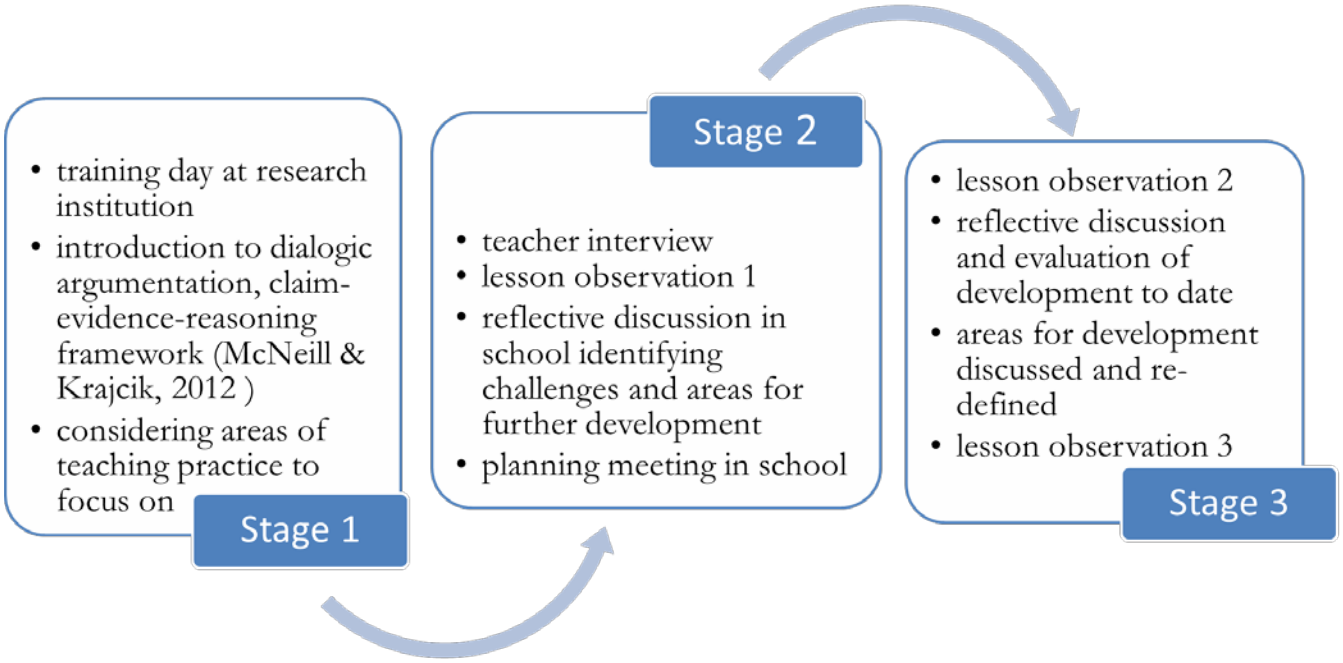
Stage 2
teacher interview
lesson observation 1
reflective discussion in school identifying challenges and areas for further development
planning meeting in school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planning meeting in school
Stage 3
lesson observation 2
reflective discussion and evaluation of development to date
areas for development discussed and re-defined
lesson observation 3

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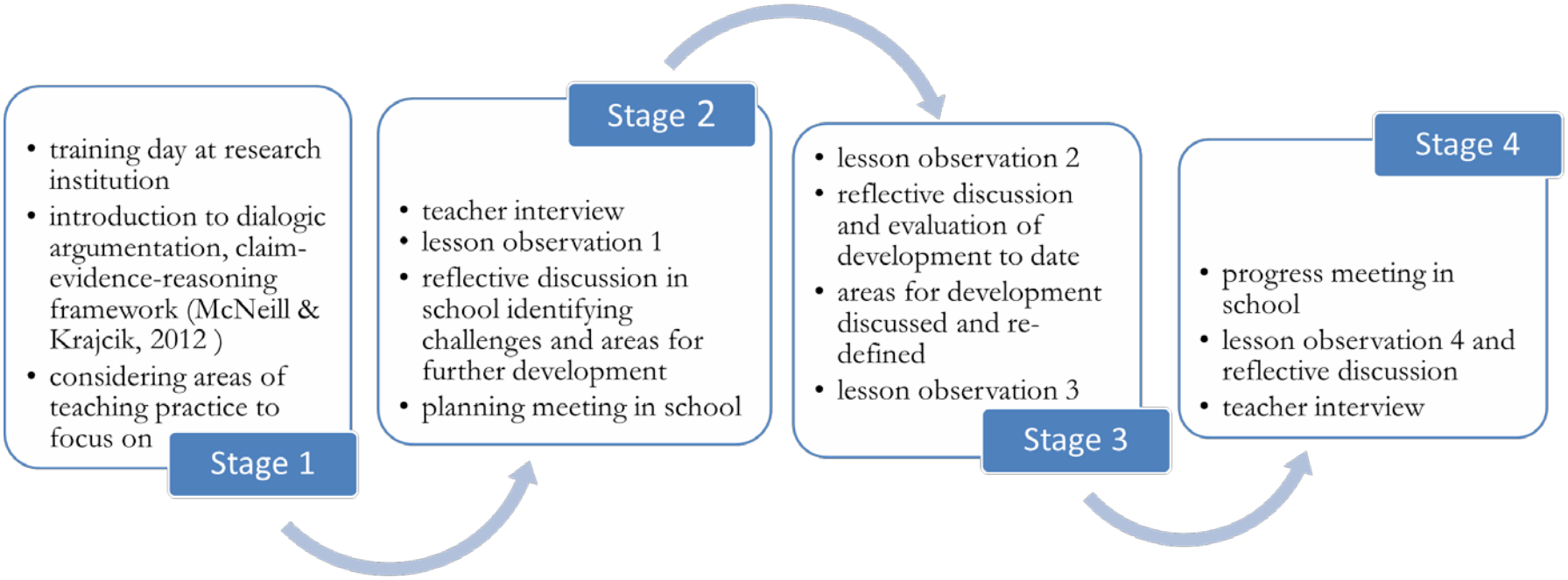

Lesson observations

Lesson Focus	Aspects of argumentation used	Dialogic activities
L1: Ethical and moral implications of cochlear implants	Supporting a claim using evidence Verbal and written argumentation	Talk partners Listening triads (groups of 3 which take on different roles)
L2: Should smoking and drinking whilst pregnant be banned?	Emphasis on evidence; providing reasons, justification; counter-argument and evaluation	"Statement, evidence, reasons" framework Solo-pairs-fours
L3: Evaluating evidence	Evaluating evidence and written arguments	Pairs to fours Whole class discussion
L4: different conclusions can be drawn from the same data: the case of the MRSA bacterium	Evaluate evidence, construct arguments & counter-arguments Persuasion	Pairs to fours Whole class discussion

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Choosing a focus for AR cycle and first challenges: talking science based on argument

- Chosen area to focus on was communicating science in a Y7 class
- Students were not able to produce written arguments of the same quality as their oral arguments

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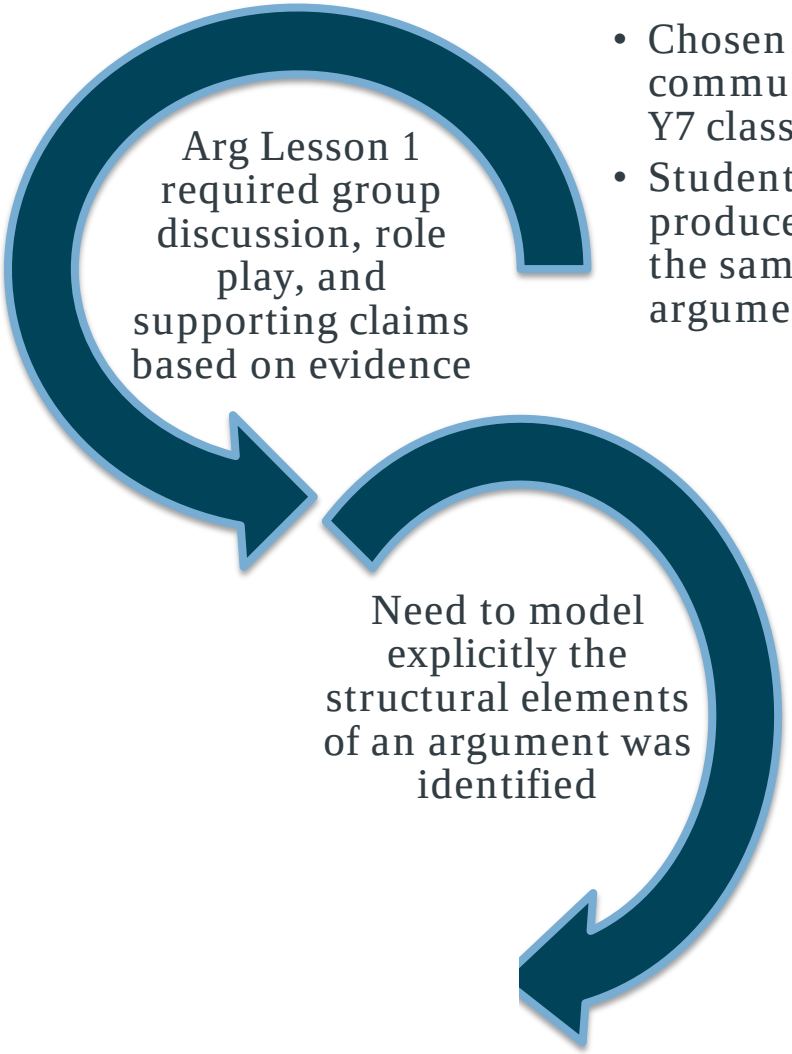

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- Emphasised justification (e.g. through questioning) as a starting point

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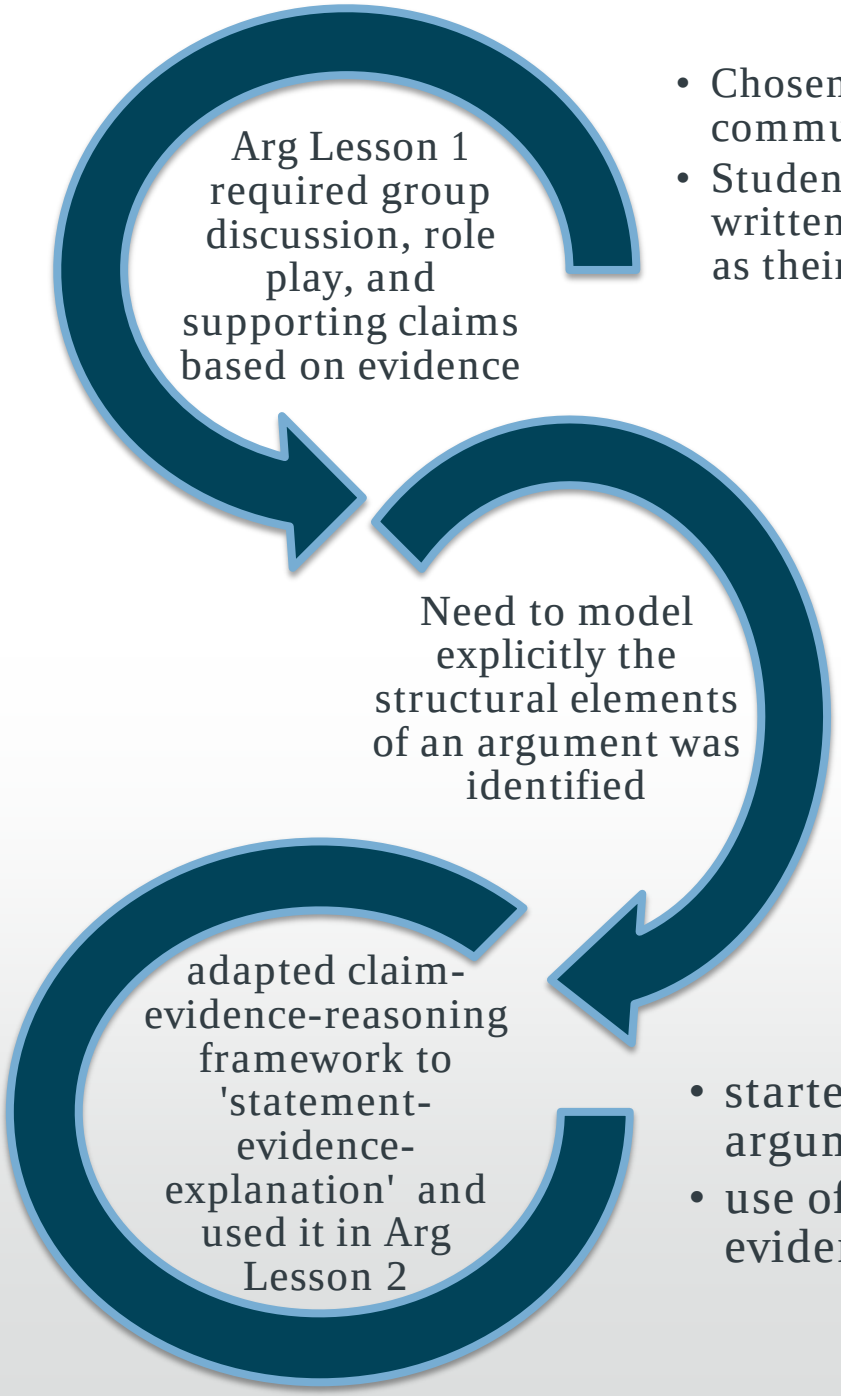

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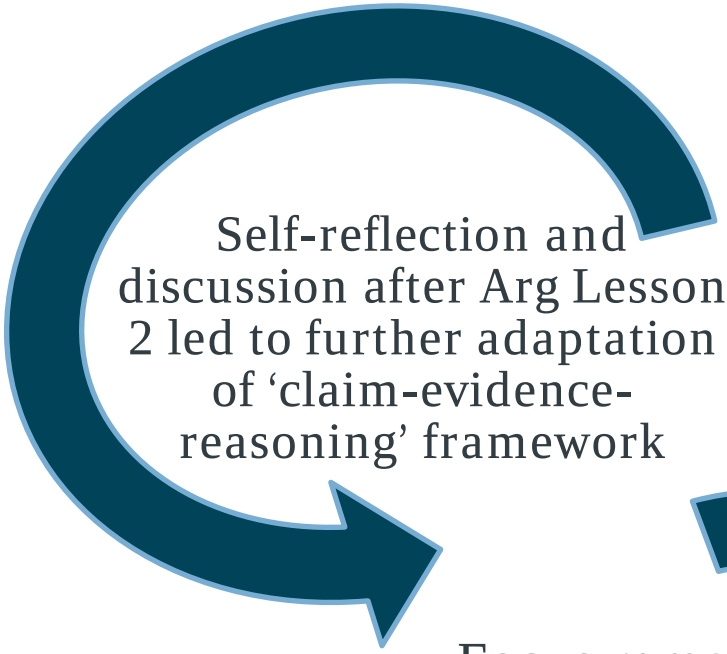
- started developing argumentation PCK in practice
- use of meta-language (e.g. evidence, reasons)

‘we’re going to look at some evidence and we are going to come to form conclusions based on the evidence we see today. So you may have already got an opinion but we’re going to put that out of our mind for now and we’re going to look at some evidence. So today we’re going to evaluate the evidence we’re going to look at based on the smoking and drinking. So we’re going to make a conclusion based on what we learn today’ (Lesson 2)

Teacher:	Okay, Lia, which one's the odd one out and why?
Lia	The one on the swimming.
Teacher	The swimming. Why do you think that?
Lia	Because that is doing an exercise, that's not anything bad.
Teacher	Okay, so you're not harming your body. Christina, do you agree with Lia? Is that the odd one out?
Christina	Yes.
Teacher	Okay, Grace, have you got something different?
Grace	The other two were smoking and drinking that were harming the baby but swimming was helping.

Reflecting on own practices and developing argumentation practices

- ‘Statement, evidence, explanation’ based on ‘Point-Evidence-Explanation’ used in English lessons
- Continued pair and group discussions



Self-reflection and discussion after Arg Lesson 2 led to further adaptation of ‘claim-evidence-reasoning’ framework

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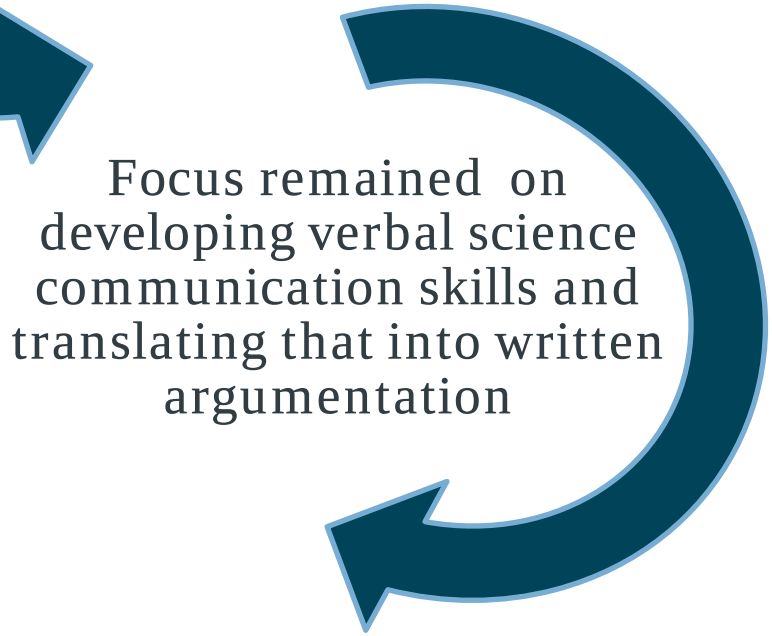

Focus remained on developing verbal science communication skills and translating that into written argumentation

- Same focus applied with a Year 9 group
- Counter-argument and evaluation become evident in planning & teaching (e.g. Arg Lesson 3)

‘I feel that I am using it more consistently now and with the Year 9s [14-15 year olds], when we do coursework, I try to model it for them […] I use the language more explicitly, “what’s your explanation” “you need to include reasons, you need evidence”

t, evidence, explanation’
Point-Evidence-
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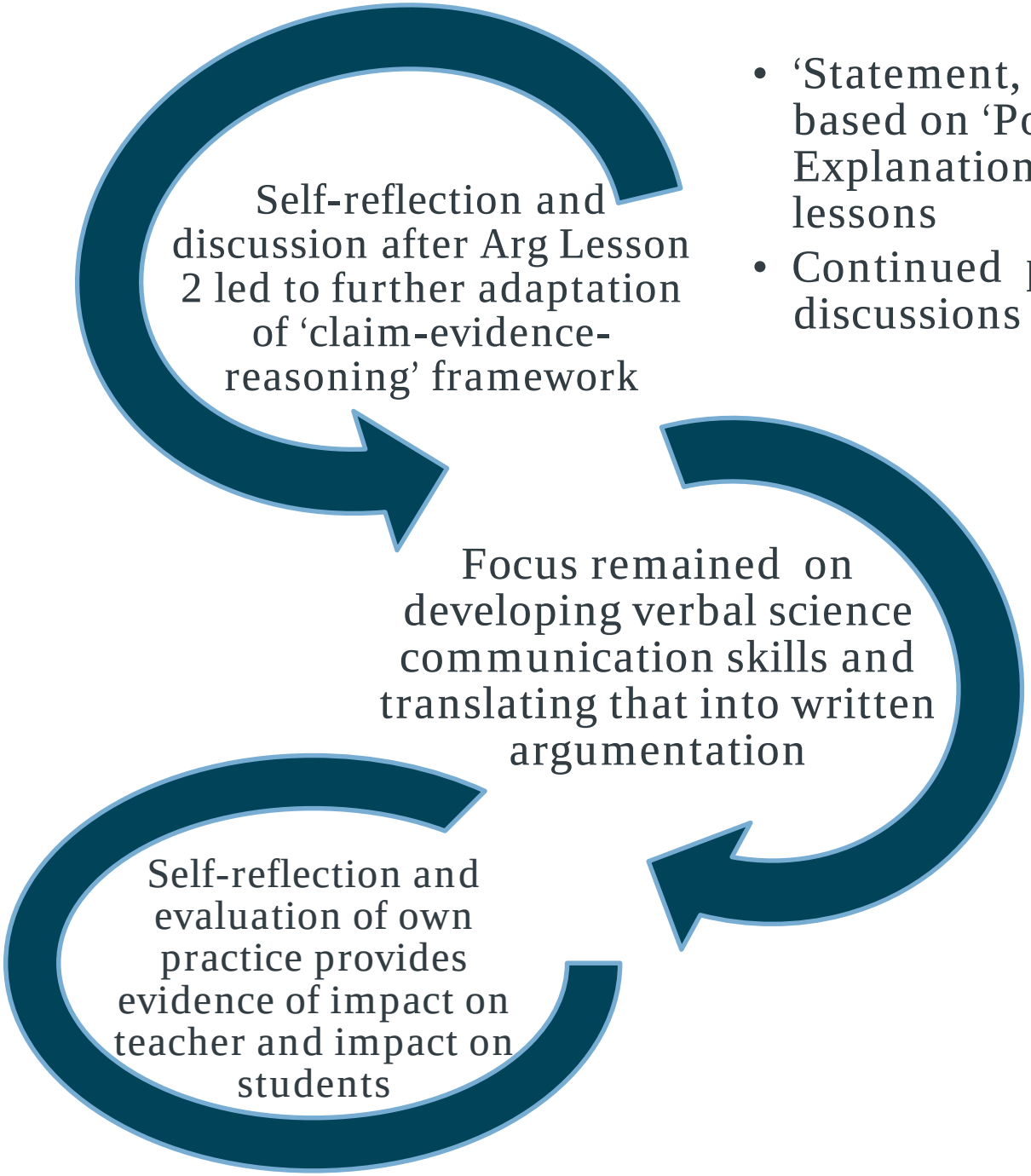

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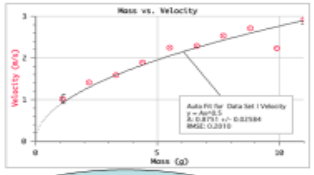
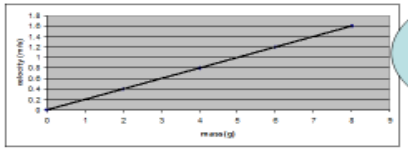
What is the relationship between the mass of an object and the speed it falls?

LO- to justify a conclusion based on evidence

Jack-The relationship between weight and the speed of a falling object object hits the ground is linear





Jill- The relationship between weight and the speed of a falling object hits the ground is non linear

What is the relationship between the mass of an object and the speed it falls?

LO- to justify a conclusion based on evidence

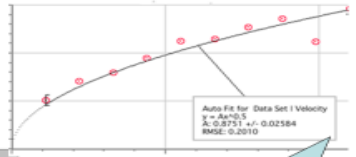
Outcome- use evidence and scientific knowledge to form a persuasive argument about who is right

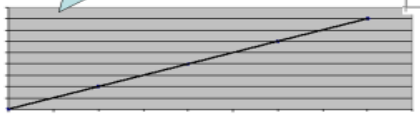
Statement
Evidence
Explanation
Counter argument (why may the other person be correct, how good was your evidence?)
Summarise

What is the relationship between the number of coils on an electromagnet and its strength?

LO- to collect accurate data to be able to justify a conclusion

Jack-The relationship is linear





Jill- The relationship is non linear

Should we be allowed to clone?

LO- to explain the ethical and moral implications of cloning

Conclusion
We should/should not clone because…
My moral reason is…
My ethical reason is…
The counterargument is…
The evidence for this is…

Interviewer: What about the impact on students?
Laura: *I think it makes them want to know more.*
Interviewer: Why do you say that?
Laura: Because before, they would write a conclusion that would be it. Now, they're asking me for iPads, they're asking to look things up on the internet, they're asking me to [...] take them to the library, and they're not just happy with having a set bit of information, *they've got more of a thirst for knowledge, I think, and they want to be able to explain things, especially the Year 7s.*
Interviewer: Why do you think there's this emphasis on explanation?
Laura: Yeah, because I've been saying, 'Well, you should explain that', and I have always had lots of different books in the cupboards, and I say, 'You can go and use any of my books that I've had from A-Levels or my degree, or any books I've got on the way', and they've really... *I don't know, for some reason, that's the first time my cupboards' ever been used.* I used to have all these books in there and no one would do it when I said it before. And they like having different... Not being able to do all the same set tasks. *They like having been able to go their own routes and find out what they want to.*

Discussion

The teacher taught successful argument-based lessons, and noted the impact of her changing practice on her students' (a) use of the language of science, (b) attitudes towards collaborating, and (c) ability to use evidence in support of their claim

- ✓ The action research design allowed the teacher to focus on very specific aspects of argumentation in relation to her pupils, their needs and her own needs
- ✓ Progressive adaptation of structural elements of argumentation enabled the teacher to embed such elements in her everyday practices and classroom discourse (e.g., use of evidence, reasons)

- ✓ Role of researcher as 'a critical friend' (Kember et al., 1997) in the process of action research facilitated reflection on own practices and provided suggestions, resources or helped teacher identify potential solutions to problems arising
- ✓ Opportunities for critical self-reflection of own practices (McNiff, 2013) facilitated the development of argumentation PCK
- ✓ The developing self-confidence in own argumentation practices was strengthened by observed positive changes on student learning, which facilitated further engagement with argumentation practices

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Implications for PD

- ✓ Direct application of small, specific aspects of argument-based instruction into classroom practice

- ✓ Space for ‘reflection-on-action’

Thank you!

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