Promoting learning in the science classroom using an innovative model of learning discourse.

Study background information

- The study took place in a secondary school in a mixed Academy in London (KS3 year 8)

- The reason behind this study was that the school identified Key stage 3 students in the science department as requiring interventions to promote their learning. This was considered by the school as part of **raising students' achievement in science.**

- The science department intend improving students' engagement and application of science? **Scientific concepts…. Students questions……. Responding to questions in exams? Misconceptions? Scientific literacy**

KS3 science assessment in the school

- Over reliance on science practical/investigation
- Is this a recipe to learning or planned for?
- Project/homework

- AfL strategies: checking progress of students- self/peer assessments, questions and feedback, marking (WWW/EBI), success criteria
- If questions and feedback are used to support learning, why is this not having positive impact on the students' engagement

What is AfL?

- Student talk in lesson is vital in promoting interactions between teacher and students and student-student
- Promoting student talk can help them to develop high order questions (Williams, 2011) and quality feedback
- Focused assessment (questions and feedback) will help to raise standards among students and enhance their progress and attainment (Black and Wiliam, 1998; Harlen, 2009) in the tasks they are engaged with.

What is AfL and how is it relevant to us?

DFE……

Class room pedagogy

- Questions/feedback have mainly focused on teachers
- Teachers have been trained to ask questions and give feedback to students rather than students giving feedback to each other. So how can we train students to ask questions and give feedback?
- Teachers who create opportunities/train students to develop questions and feedback promotes good pedagogical knowledge…..
- Studies?..... Most students have not been given opportunity to express themselves in lessons, such as using talk and giving feedback to other students.

Our thoughts 1

- How can we promote KS3 science students' engagement in their learning?
- We want to avoid practical work
- We want to focus on questions and feedback as means to engage the students as per the HOD science concerns- students do not ask questions and overreliance on practical work by teachers….
- PBL/Problem-solving?
- Student-led activities?
- Teacher as facilitator and less involvement in the task- reduce/avoid teacher talk…….
- How can we measure their progress from the problem solving tasks?- success criteria/scoring their presentations?..... etc

Research question

How can student-led questions and feedback be used to enhance students' engagement and attainment in a Learner-centred Key Stage 3 science classroom?

There were subsidiary questions focusing on student-student interaction in question and feedback as means to promote engagement, as well as teachers' perceptions of its use.

Reiss and Ruthven (2011) identified students' engagement in science as a concern that needs a solution in order to support students' learning and retain their interests in the subject?

Eureka moment

We explored some studies- questions, and identified areas of concerns to us:

- Students were not given direct instructions to ask questions as the authors feel they do ask questions in lesson. What is the quality of questions the students are asking?
- In another study, students were not given samples of questions to guide them but were instructed to ask questions. My experience of doing this?
- Studies focused on teachers' questions

Taxonomies of learning- our thoughts 2?

- Bloom's taxonomy
- Socratic questioning
- Solo taxonomy

Decision

- We used Bloom's taxonomy because it is common among teachers…..
- However, pilot study reveals that some teachers do not use Blooms even when they know it is useful? Some say they forget or can't be bothered.

Common models of discourse- our thoughts 3?

- Model 1: I-R-E pattern in which the teacher initiates a question (I), the student responds (R) and the teacher makes an evaluation (E) (Cazden, 2001).

- Model 2: “This is the closed chain of interactions, I-R-P-R-P-R-E. The question is initiated by the teacher (I) and the student responds (R), followed by teacher prompts (P) to generate further responses. The sequence is finally closed with an evaluation (E) by the teacher”.

We were interested in model 2…

Common models- our thoughts 3?

- Model 3: The open chain of interactions called I-R-P-R-P-R (Scott, Mortimer, and Aguiar, 2006) which has the same format as model 2 but does not involve an evaluation by the teacher
- Model 4: This is suggested by Lemke (1990) and it is called the question- and- answer pattern. This involves students initiating the questions and teachers responding to them.

We were interested in model 4…

Common models

- Our interest was on models 2 and 4 but with the intention of making it more student-led with a focus on developing a new model.

"Students learn better when they express their developing knowledge either through conversation or by creating papers, reports or other artefacts and then are provided with opportunities to reflectively analyse their state of knowledge"….. An inspiration

PBL – our thoughts 4?

- What is problem-solving
- What does research say about PBL……..?
- Research shows that problem-based learning is sparingly implemented by secondary school teachers (Merritt et al., 2017), especially in science, and may be due to a lack of pedagogical knowledge.

Approaches to designing PBL

- Barrows (1986)- medical education
- Hung (2009) 3C3R model
- OECD (2014) model

PBL

- Barrows (1986) ten steps to PBL:

encounter an ill-defined problem; have students ask questions about what is interesting, puzzling, or important to find out; pursue problem finding; map problem finding and prioritise a problem; investigate the problem; analyse results; reiterate learning; generate solutions and recommendations; communicate the results and conduct self-assessments.

Designing PBL- our choice

- Hung's (2009) 3C3R model of problem-based learning.

The 3C represents content, context and connection while the 3R indicates researching, reasoning and reflecting.

- Hung's (2009) 3C3R model is a systematic conceptual framework that builds upon 9 steps of problem design process:

9 steps PBL process

- Set goals and objectives; conduct content/task analysis; analyse context specification; select/generate PBL problem; conduct PBL problem affordance analysis; conduct correspondence analysis; conduct calibration processes; construct reflection component and examine inter-supporting relationships of 3C3R components.

3C3R PBL process

- The next step is to set research tasks focusing on the contents that students will be exploring. This is situated within a context that creates connections with other related areas. Subsequently, allowing students to find information about the problem….. 3C3R process- 3C represents content, context and connection while the 3R indicates researching, reasoning and reflecting.

- An example of the problem-solving task developed…….

PBL

We trained the students on how to use Bloom's taxonomy question prompts to create questions.

Students work in groups to solve problems etc, present findings to other groups who ask questions and give feedback.

Teachers scored their presentations. The success criteria for this presentation was adapted from OSLA (2012) model of inquiry

Presentation criteria …

Bloom's taxonomy prompts used…..

Use the following words to develop your questions

1. Knowledge
-**Who, What, Why**
-**Can you tell why**
-**Describe**

2. Comprehension
-**State in your own words**
-**What do you think might happen next?**
-**What does this mean**
-**What is the main idea?**
-**Give an example**
-**Can you define?**
-**Explain**
-**Judge**
-**Classify**
-**What difference exists between.....?**

3. Application
-**predict what will happen if.....?**
-**what factors would you change if.....?**
-**judge the effects of.....?**
-**Tell how, when, where, why.....?**
-**What questions would you ask of.....?**
-**What would result.....**
-**Do you know another instance where..?**

4 Analysis
-**How is.....similar to .....?**
-**Can you compare your.....with that presented by.....?**
-**Can you state the difference between.....**
-**What motive is there.....?**
-**What conclusions can you make.....**
-**What is the relationship between.....?**
-**What are some of the problems of.....?**
-**Can you explain what must have happened.....?**

5 Synthesis
-**What would happen if.....?**
-**How many ways can you.....?**
-**Can you create.....?**
-**Can you make up.....?**
-**Can you design a .....?**
-**Can you develop.....**
-**Choose**

6 Evaluation
-**Is there a better solution to.....?**
-**Judge the value of.....**
-**Can you defend your position about.....?**
-**What changes to.....would you recommend?**
-**What do you think about.....?**
-**Find the errors with.....?**
-**Compare or defend.....?**

The new model of discourse

- The new model of discourse from questions and feedback is represented as SI-SR-SP-SP-SR-SP-SR-SP-SP-SP-SR-SP-SE, where SI is student initiation of questions; SR is student response; SP is student probing; and SE is student evaluation (SE).
- Summary of the model: SI-SR-SP-SE

Outcome

- Progress tracked weekly- questions and feedback e.g. students began to develop high order questions, with quality feedback
- Students leading their own learning
- Teachers' pedagogical knowledge…
- Improvement in engagement and attainment of students.
- Constructivist perspective/framework
- New model

Outcome

- In this model, the role of the teacher is to work with the students' ideas, help students create a model for self-correction/address misconceptions.
- Scientific reasoning and argumentation which are crucial elements of scientific learning
- While reasoning is an important tool for activating learners' sense-making and cognitive comprehension
- Argumentation as a skill.
- Advanced meta-conceptual understanding of science thus facilitating the advancement of meta-cognitive understanding.