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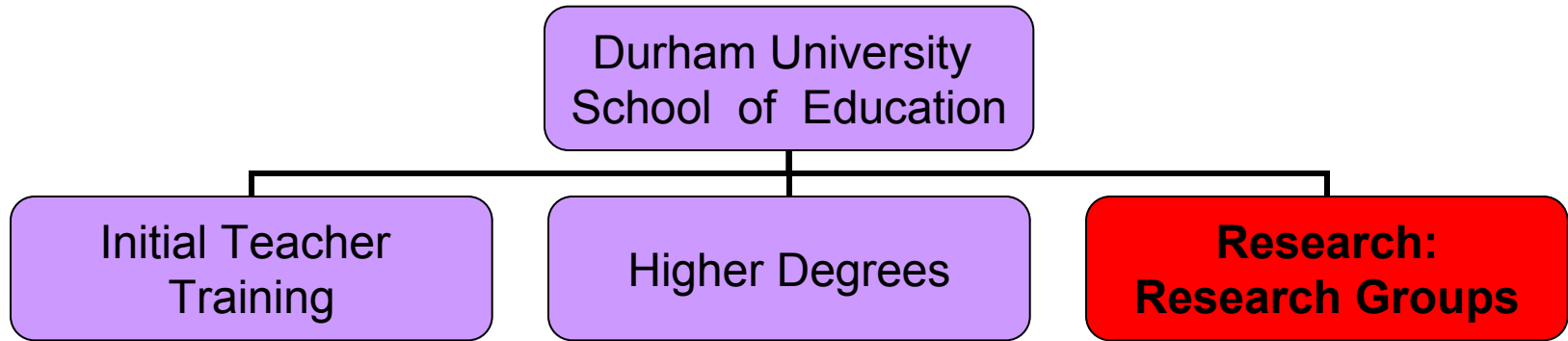
Creativity in Elementary Science

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Research in the School – seven groups:

assessment and evaluation

curriculum and pedagogy

language & intercultural education

new technologies and education

SMT Ed (science/mathematics/design technology)

philosophy and ethics in education

psychology of education & inclusion

sociology and the arts

The Curriculum and Pedagogy Research Group: Creativity across the Curriculum



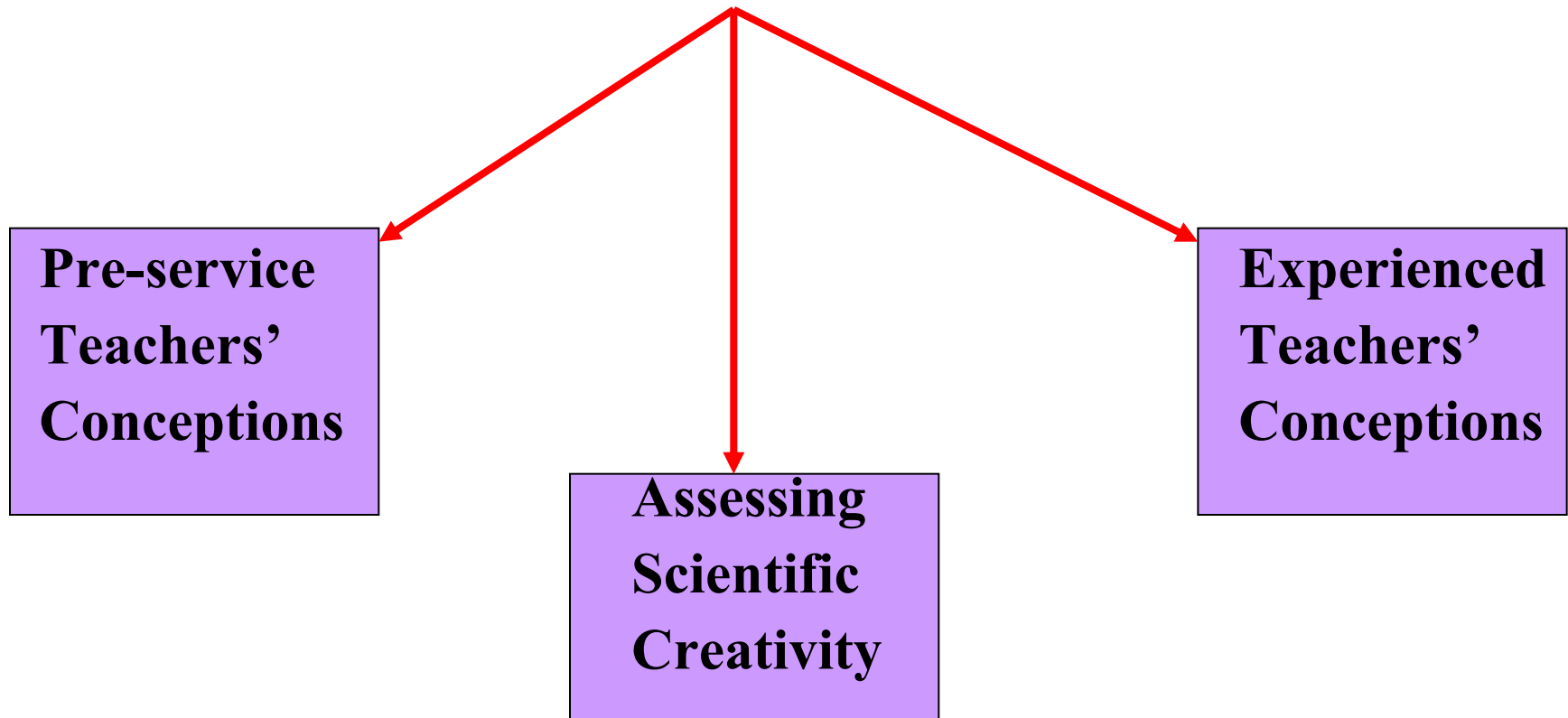
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Creativity in Science Education

Creativity in the science classroom



Creativity

**Mental activity intent on
producing something**

new, novel

**appropriate, plausible,
functional**

ethical

elegant



Creativity in Science (Field 1)

Making sense of the world

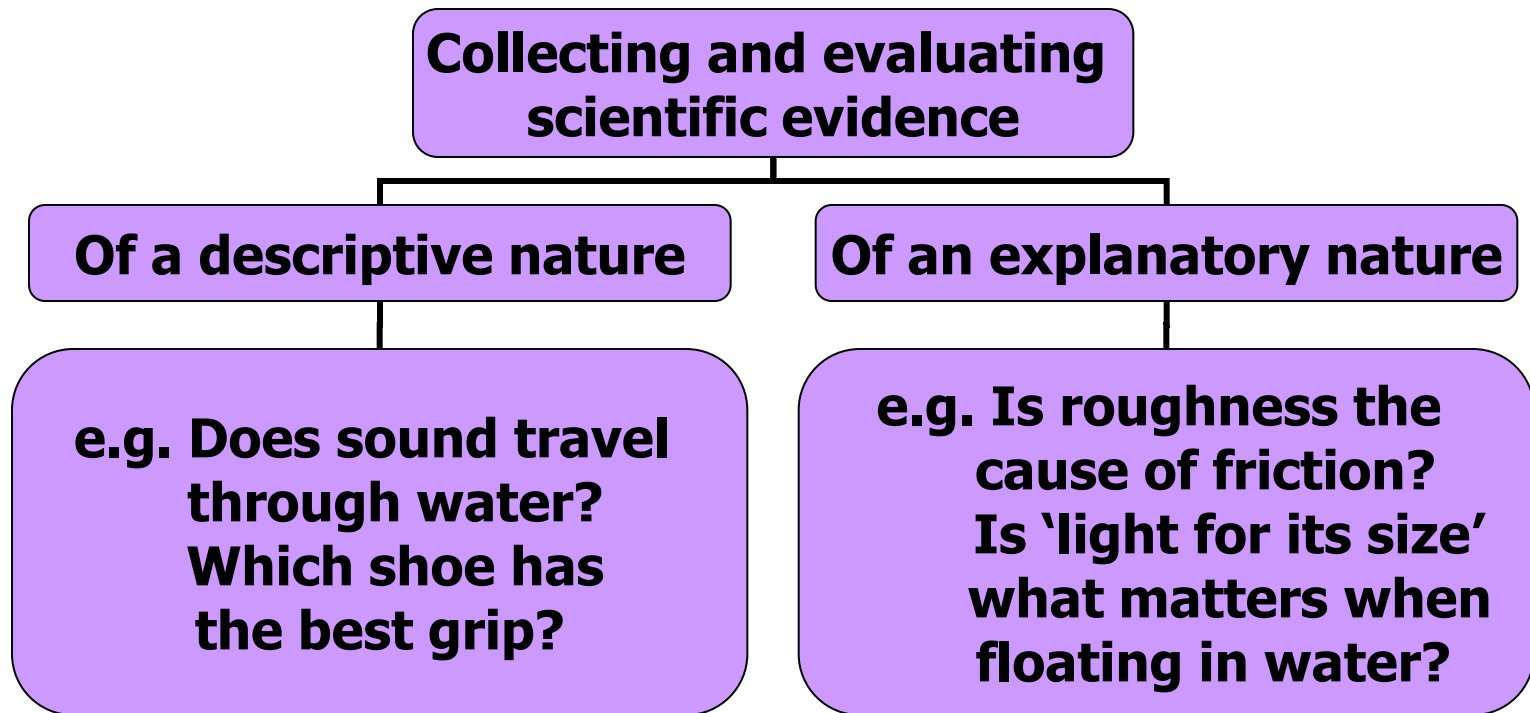
**More or less
speculative descriptions**

**e.g. Imagine life on Mars
Pumice is like cinder toffee**

**More or less
speculative explanations**

**e.g. Of the image in a mirror
Why a large object tends to
make a low note**

Creativity in Science (Field 2)



Creativity in 'Science' (Field 3)

**Technology:
Applying science**

Make a waterproof roof for your house

Pre-Service Teachers

How do pre-service teachers think of creativity in science?

Do they see science as being creative?

How well do their conceptions match the three categories of creativity in science?

What we did

A structured questionnaire

Semi-structured interviews

**Phenomenographic analysis of responses to
identify categories of conceptions (Marton,
1981)**

Pre-Service Teachers Involved

16 final year undergraduate students taking a primary science leadership module.

All completed the questionnaire.

All were interviewed.

The Questionnaire (1)

General information about conceptions, for example ...

2. Which subjects offer more opportunities for creative thought than science? (Select from this list and tick)

English	Drama	MFL	Maths	RE
History	Geography	Music	Art	PE
ICT	D&T	Any other subject? (Please specify)		

.....
.....

3. What makes these have more opportunities?

The Questionnaire (2)

About teaching Science, for example

9. Which topic would you like to teach or enjoy teaching in science?

Suppose you taught this topic. Are there opportunities for scientific creativity in it?

10. If so, what are they?

11. Please state what is creative about them.

Questionnaire (3)

About Science as a discipline, for example ...

15. Here is a list of aspects of science. Which of them do you see as offering the best opportunities for scientific creativity?

- *Ourselves and other living things*
- *Variety of life*
- *Materials and their properties*
- *The Earth beneath our feet*
- *Electricity*
- *Sound*
- *The Earth in space*
- *Keeping healthy*
- *Environments*
- *Changing materials*
- *Magnetism*
- *Light*
- *Forces*

The Interviews

Individual interviews

Duration 20 - 30 minutes

To clarify, extend and supplement the responses to the questionnaire

e.g. what was seen as meriting high (or low) marks for creativity in the lessons described.

Some pre-service teachers' conceptions of creativity in elementary science lessons

1.1 Construct descriptions

1.2 Construct explanations

2.1 Construct tests of facts

2.2 Construct tests of explanations

**3.1 Use science knowledge to solve a practical problem
(applied science/technology)**

**4. Making things and science lessons which
excite**

Pre-service teachers' conceptions of creativity of a scientific nature

Category 1

1a Children experience the world and generate explanations.

1b Children experience the world, generate explanations and test them.

Pre-service teachers' conceptions of creativity of a scientific nature

Category 2

2 Children imagine using information.

Pre-service teachers' conceptions of creativity of a scientific nature

Category 3

- 3a Children do fact-finding investigations.**
- 3b Children apply scientific knowledge.**
- 3c Children do fact-finding investigations and apply what they find.**

Pre-service teachers' conceptions of creativity of a scientific nature

Category 4

4 Children's positive feelings about science are aroused by the lesson.

Pre-service teachers' conceptions of creativity of a scientific nature

Category 5

5 Children make or do things in science.

So what does this tell us?

Pre-service teachers held narrow views of creativity in science.

Some had misconceptions.

The focus was on creativity in devising experiments to find facts.

Science was seen as offering fewer opportunities than some other subjects.

The pre-service teachers had little or no grasp of assessing creativity.

Experienced Teachers' Conceptions

How do experienced teachers think of creativity in science?

Do they see science as being creative?

How well do their conceptions match the three categories of creativity in science?

What we did

Three instruments:

- 1. Earth, Space and Gravity**
- 2. Electricity**
- 3. Plants and Animals**

**Each comprised 12 episodes from the science classroom,
e.g. ‘The children see the dents that marbles make in a
sand pit and are asked to explain the craters on the
Moon.’**

0 1 2 3 4

Given to 23 experienced teachers.

e.g. *Electricity, Episode 15:*

‘Following instructions in a book, the children use torch bulbs and batteries to make a set of lights to decorate a small cardboard tree.’

0 1 2 3 4

(REP/F3)

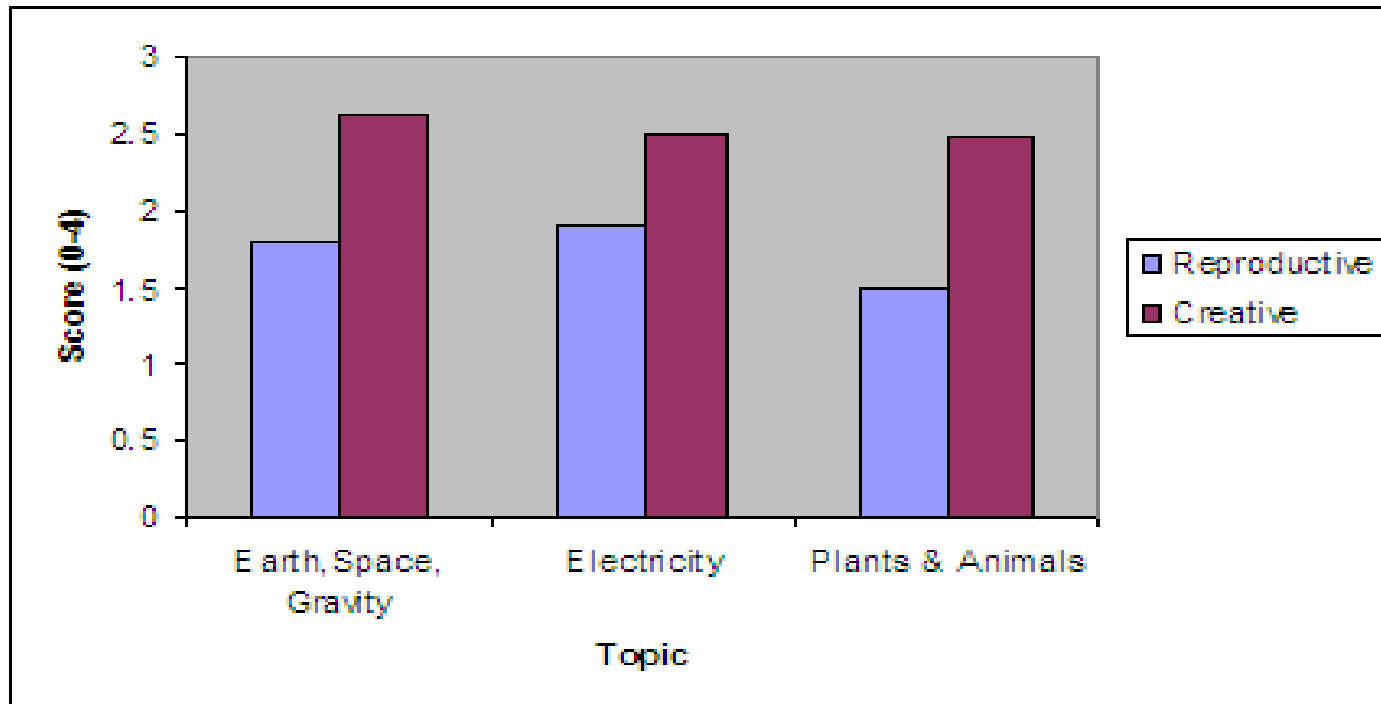
e.g. *Plants and Animals, episode 29:*

‘After hearing what hibernation is, the children think about how they will test places to find the best one for a hedgehog [ein igel; un hérisson**] to spend the winter.’**

0 1 2 3 4

(CR/Des/F2)

Some experienced teachers' conceptions of creativity in elementary science lessons



So what does this tell us?

Experienced teachers could distinguish between incidents that favour scientific creative thought and those favouring reproductive thought.

They generally favoured fact-seeking practical activity and the application of such information to solve practical problems as opportunities for creative thought.

The same pattern of judgement was found in all topics, it was more marked in some topics than others.

They had little or no grasp of assessing creativity.

Pre-service and Practising Teachers Compared

Pre-service teachers:

- narrow views of opportunities for creativity in science
- some had misconceptions
- focus on creativity in devising experiments to find facts
- science seen as offering fewer opportunities than some other subjects
- little or no grasp of assessing creativity

Experienced teachers:

- generally, broader view of opportunities for creativity in science
- favoured fact-seeking practical activity and the application to solve practical problems
- little or no grasp of assessing creativity

Little or no grasp of assessing creativity.

Assessing Creativity in the Science Classroom

Little or no grasp of how to assess creativity.

Assessing creativity – is it difficult?

Some argue that it is easy if done intuitively and holistically.

They find a high level of agreement between assessors.



Is this true for the science classroom?

What we did

We used five sets of explanations representing five different science classroom contexts.

Each set of explanations was assessed by ranking them for creativity.

12 pre-service teachers completed the task for each set.

We found very different results – low level of agreement.



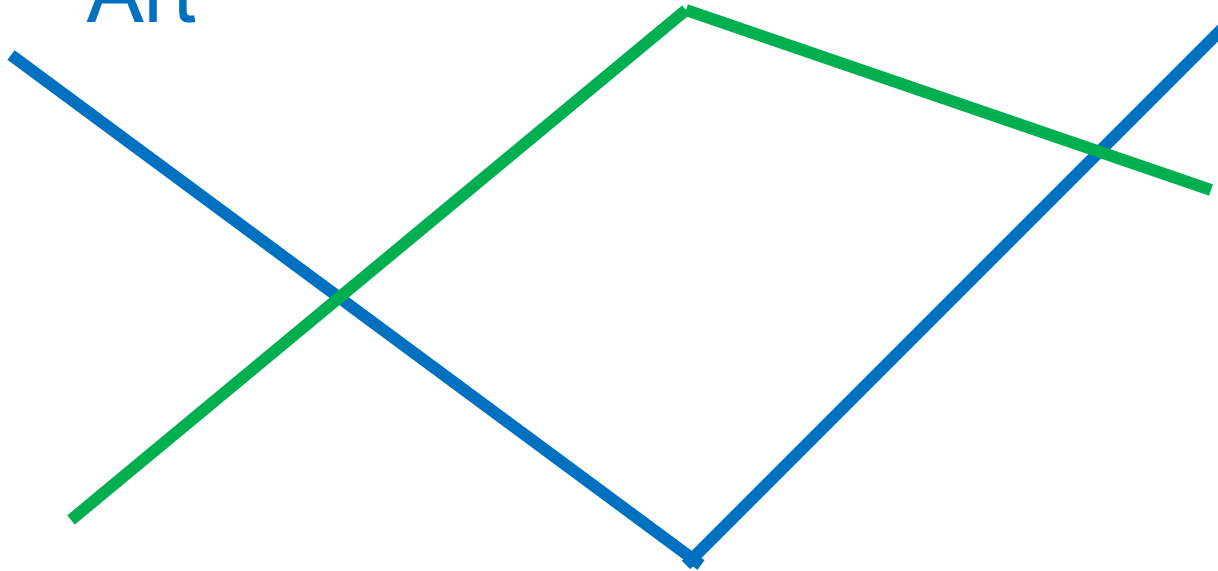
Why did the assessment fail?

Novel

**Appropriate
Functional**

Elegant

Art



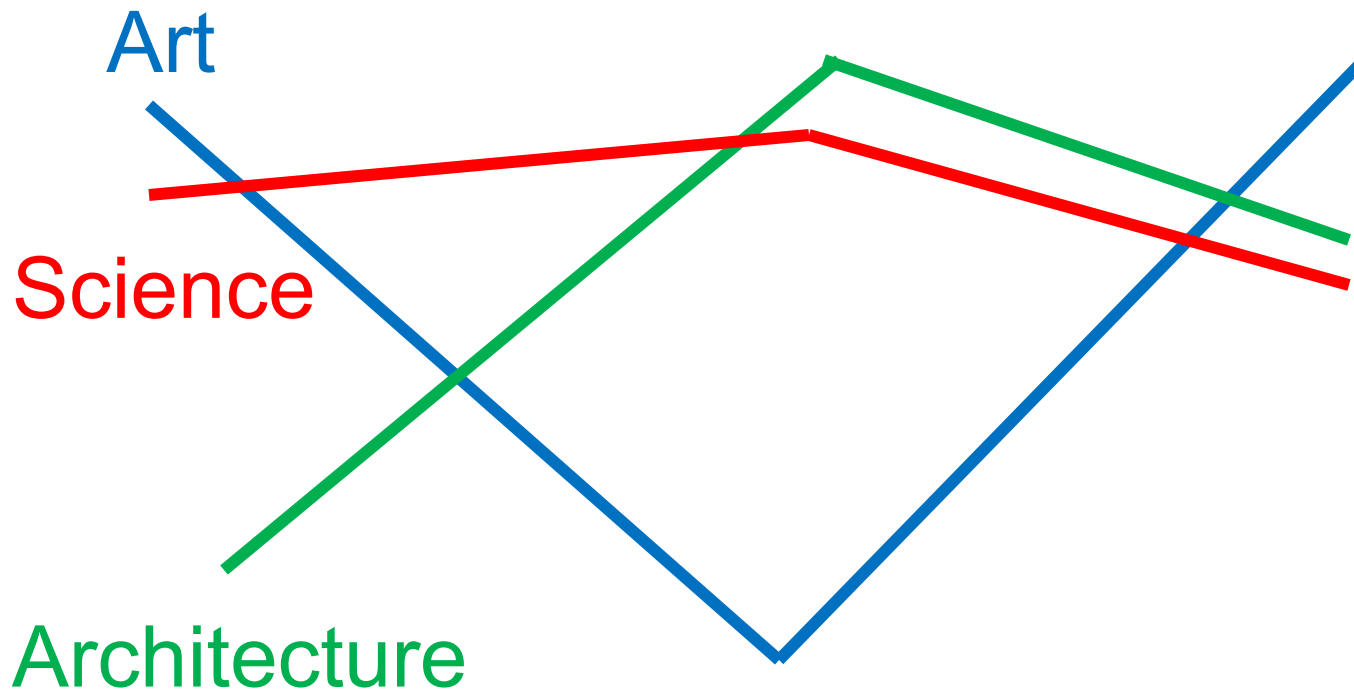
Architecture

Why did the assessment fail? Reason 1

Novel

Plausible

Elegant



Why did the assessment fail? Reason 2

Novel to the CHILD

Plausible to the CHILD



**Not necessarily to the
teacher**



The children's world

Some conclusions

Teacher trainers should expect narrow views and misconceptions.

The popular association of creativity with the arts may limit or misdirect thinking in this context.

Thinking in terms of ‘productive thought’ may be helpful.

Where to from here?

- **Extend study to include other trainee teachers;**
- **Explore extent to which trainees have greater difficulty thinking of creativity in different areas of science (Biology, Chemistry, Physics);**
- **Determine the prevalence of the categories amongst teachers generally;**
- **Review of science education training programme to incorporate a more explicit focus on creativity in science lessons;**
- **Specific training for science education tutors.**

References

Newton, D.P. & Newton, L.D. (2009), *Some student teachers' conceptions of creativity in school science*, Research in Science and Technological Education, Vol. 27, No. 1, pp. 45-60.

Newton, L.D. & Newton, D.P. (2009), *What teachers see as creative incidents in elementary science lessons*, International Journal of Science Education,

Thank you all for listening – any questions?

