



ESCalate Developing Pedagogy and Practice 2009 Grant Project Final Report

Date submitted	16 March 2011
Project Title	Researching beginning science, maths and English teachers' pedagogies. Applying learning theory to inform enriched planning and practice.
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Researching beginning science, maths and English teachers' pedagogies. Applying learning theory to inform enriched planning and practice.

FINAL REPORT

Prepared by Dr D. McGregor

(January 2011)

The final report is in six parts as requested.

1. Top line summary

This study compares the pedagogic strategies that beginning teachers in English, mathematics and science plan to enact for their learners.

The findings indicate there is a difference in the ways they intend learning to arise.

As anticipated beginning English teachers organise and manage earlier in their development for social constructivist learning. Mathematics and science trainees organise for pre-dominantly constructivist learning, e.g.: asking individuals challenging questions or for their inferences from data. Interestingly. Though, two mathematics and science trainees paid attention to socio-cultural aspects indicating they were designing learning to be more inclusive and engaging for *all* the class.

There are also indications that strategies of beginning teachers generally develop to nurture and support more socially interactive learning towards the end of the first training year.

The implications of this are that beginning pedagogues and their tutors could find it useful to apply the analytical learning theory framework developed through this project. It is possible to scrutinise plans and teaching (in-action) using the framework to discern whether learning is behavioural, constructivist, socially constructivist or socio-cultural in nature.

2. Project overview

Background to the project

Working with trainees, especially in STEM subjects (like mathematics and science) that contrast in nature to English, it appeared that the content and skills required of the subject influenced quite strongly the ways that trainees taught those subjects.

Arguably, science and mathematics lend them selves intuitively to more behaviourist modes of learning because there is much *content* and *factual information* to be conveyed to the learners. There are also particular protocols or ways of doing things to be learned too. To communicate much information and show *how* to do something beginning teachers may find it easier to demonstrate new skills, techniques or phenomena. Trainees may therefore initially employ pedagogic strategies that support more behaviourist learning (rote learning, repeatedly practicing for good performance, copying notes etc). They may then extend their repertoire from didactic approaches, over time, to more constructivist and then more socially interactive ways of their pupils learning together.

The nature of English, however, focuses rather more on developing learners' subjective views and interpretations of text, literature and happenings rather than ensuring a more objective delivery facts. Beginning teachers may intuitively adopt, at the onset of their development in practice the use of more discussion and working in groups to support the sharing of different perspectives. The development of more reasoned and justified personalised understandings, shared with others is informed by the curricular demands of learning about and inferring linguistically meanings. Appreciating other viewpoints is more comfortable within subject matter that is not hard-nosed and very matter of fact.

In short, we predicted we would find a difference in the types of learning supported by the developing pedagogues in these three key subject disciplines.

This study set out to address the following 3 aims.

The 3 main aims:

1. To explore how do maths, science and English trainees differ in the way that they conceptualise their teaching?
2. To scrutinize trainees' assignments and practice to draw out what appear to be common components (across subjects) of novice pedagogy applied to support learning?
3. To consider whether there are there implications for the ways that pedagogy development (across and within subjects) can be better nurtured and supported in HEI's?

To address these aims, we devised the following research questions.

The research questions :

1. How do mathematics, science and English trainees differ in the way that they conceptualise their teaching?
 - a. What kinds of learning experiences do they consciously organize for?
 - b. How closely are intentions (evidenced by planning) enacted in practice?

- c. Is one kind of learning more prominent in a subject discipline than another?
2. What appear to be common components (across and within different subjects) of novice pedagogy applied to support learning?
3. Are there implications for the ways that pedagogy development (across and within subjects) can be nurtured and supported in HEI's?

Methodology

Gathering the data

The project team (involving Mary Dunne (English PGCE pathway leader); Mike Rickhuss (Mathematics PGCE pathway leader); Peter Taylor (Science PGCE pathway leader) gathered lesson plans and tutor observations of a representative sample of 40 to 50% of their trainees. The exact numbers involved are indicated on Table 1 below. Originally it was intended that we would gather all the trainees lesson plans, but that was too onerous a task and the scrutiny of the documents (and accompanying observations) were too time consuming to analyse them all.

The trainees' plans *and* observing tutors notes (where available) and trainees reflections (or self evaluations) were also used to verify the lesson intentions and enactments where the beginning teacher's actions were unclear.

The framework described in Table 2 below, indicates what features were sought in the planning (and observation) documents to signal what kind of learning was happening in the trainees' classrooms.

Data gathered and analysed

Practice of 25 trainees were analysed (11 mathematics, 9 science, 5 English) through the scrutiny of over 66 (usually about an hour long) lessons.

	English	Mathematics	Science
Number of trainees' whose plans were scrutinized	5	10	9
Total number of lessons scrutinised	15	27	24

Table 1 : Number of trainees in English, mathematics and science whose plans were scrutinized.

The lesson plans were initially scrutinized by a researcher (Sally Howard) and the three subject tutors (and finally validated by Deb McGregor). The key characteristics of the four learning theories were applied to the above lesson plans to identify the different episodes of learning in 66 lessons. The application of the analytical framework proffered insights into trainees' intentions and practice that had not been previously explored with learning theory in mind. In addition, three trainees practice were videoed to triangulate intentions of plans against actual pedagogic practice. The videos of the maths, science and English trainees were recorded to provide a useful training resource out of the project, as well as enable a level of triangulation,

to judge how closely and accurately the planned activities are reflected in enactments of lessons. This could tentatively suggest the confidence level with which to judge pedagogical intent through trainees planning documents.

Analytical framework applied

The analytical framework was developed to scrutinise how trainees had intended to develop their pedagogy to support learning (see Appendix 1,2 and 3). The distinct episodes in each of the lesson plans examined provided quantifiable indications about how often the different types of learning were promoted. The limitations of the approach taken to note each different episode in a lesson are recognised. An alternate approach could have been to measure and analyse the time pupils were engaged in each of the different types of learning. The level of analysis, however, required for that depth of scrutiny would be beyond the scope (and researchers time available) for this project. This data scrutinised involved only plans and enactments by English, maths and science PGCE students trained September 2009 – July 2010 at Wolverhampton University.

The following characteristics of the fundamental theories of learning (McGregor 2007 p. 50 - 61) were developed as the analytical framework to scrutinize trainees planning and practice.

	Key features of analytical framework to scrutinize trainees lesson plans
Behaviourist	Teacher telling/repeating information Teacher giving instructions Teacher modeling expectations Students mimicking or repeating expected behaviours Students watching expert-in-action Lack of acknowledgement of cognitive processing
Constructivist	Teacher presents tasks that individuals should do Teacher asking directed questions (to individuals) Teacher expecting students to figure out answers individually Teacher asks challenging questions Individuals expected to think about phenomena or observations made
Social Constructivist	Teacher asking questions of groups or collective Teacher asking more open questions Teacher encouraging student to share and discuss ideas in groups Teacher presents tasks and learning activities that requires active participation Teacher nurturing co-operative and supportive learning environment Teacher expects learning to arise through interaction with others
Socio-culturalist	Teacher promotes collaborative learning through novice and expert working together

	Encourages collective responsibility for learning Anticipates learning as an apprenticeship
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Table 2 : Criteria by which lesson plans judged to provide particular learning opportunities. This informed the analytical framework.

The findings

How do mathematics, science and English trainees differ in the way that they conceptualise their teaching?

The scrutiny of lesson planning documents and observing tutors' notes were used to infer how 24 postgraduate teacher trainee students conceptualized their teaching at the start, mid-way through and at the end of their training year at the University of Wolverhampton.

Interestingly as, anticipated in the introduction, English trainees tended to plan to use much more social construction opportunities for their pupils than the math and science beginning teachers. The mathematics and science trainees appeared to offer more constructivist opportunities than any of the other approaches. Therefore English, mathematics and science trainees appeared to differ in the ways they conceptualised their teaching.

	Behaviourist	Constructivist	Social Constructivist	Socio-Cultural
English trainees				
Total number of episodes	20	36	53	0
Average episodes per lesson	1.33	2.40	3.53	0
Range of number of episodes	0 - 2	0 - 5	1 - 8	0
Mathematics trainees				
Total number of episodes	37	71	52	1
Average episodes per lesson	1.37	2.81	1.93	0.04
Range of number of episodes	0 - 3	0 - 8	0 - 5	0 - 1
Science trainees				
Total number of episodes	51	83	35	1
Average episodes per lesson	2.13	3.46	1.46	0.04

Range of number of episodes	0 - 5	2 - 9	0 - 3	0 - 1
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Table 3 : Total number of episodes, percentage episodes and range of episodes of the four types of learning planned for by 24 trainees.

From the data above in table 3, it appears that the behaviourist approaches (showing how, requiring copying or learning by rote, or repetitive practice) is more common in science than maths and English. Constructivism in the classrooms appears to be more prevalent in maths and science. This kind of learning was usually, a demonstration or explanation from the teacher followed by questions that the pupils had to answer on their own, written into their books or answered on a note sheet of some kind. A few trainees used individual whiteboards to explore their students' understandings or ideas about aspects of science or mathematics. Social Constructivism, however, involving more interaction between the pupils, appears to be more commonplace in English. Discussions organized in small groups were more frequently seen in the plans of these trainees. Often there were also questions listed for the pupils to discuss and respond to as a group with subsequent reflection by the whole class. At this later stage in the lessons there was often consideration of the variations of ideas and perspectives suggested by each of the groups. The English trainees used circle time too, where all the class would be collectively engaged in discussion about a novel, storyline or key characters in a narrative. Interestingly, socio-cultural learning opportunities where pedagogical approaches nurture the learners as apprentices learning together in mini-communities (in true collaboration) and purposely arrange for expert and novice to help each other appears to be rare in any trainees planning or practice. There were a couple of cases where it almost arose in English, and it appeared to be developed in just a couple of lessons in mathematics and science.

These episodes involved pupils discussing what task they were asked to do, consider how they would work together and what expertise they needed when designing a mathematical project to find out what the favourite meal of the whole class was. In another classroom, the pupils were organised in groups of scientists who agreed and disagreed with the big bang theory. In each group they had to empathise with differing views, find the evidence to justify why scientists might believe opposed ideas and be ready to share the varied hypotheses.

Common components of novice pedagogy across the subjects

From the evidence below (Tables 4,5,6) there appears to be a general increase in the use of strategies that promote social constructivism as the trainees develop. It can be inferred, through increased use of small groups that the developing trainees value (and/or can manage more easily) learning through social interaction. More questions are directed at the class as a whole or small groups, there is more active participation in smaller groups, there is more discussion generally and there is recognition that what arises from small group work is valuable and to be shared amongst the class.

English Trainees				
	Behaviourist	Constructivist	Social Constructivist	Socio-Cultural
Early development				
Total number of episodes	8	13	11	0
Average episodes per lesson	1.60	2.60	2.20	0
Mid development				
Total number of episodes	7	13	17	0
Average episodes per lesson	1.40	2.60	3.40	0
Late development				
Total number of episodes	5	10	25	0
Average episodes per lesson	1.0	2.0	5.0	0

Table 4 : Looking at the change over time (during a year) for five English trainees.

Mathematics Trainees				
	Behaviourist	Constructivist	Social Constructivist	Socio-Cultural
Early development				
Total number of episodes	15	21	15	0
Average episodes per lesson	1.88	2.63	1.88	0
Mid development				
Total number of episodes	9	25	13	1
Average episodes per lesson	1.13	3.13	1.63	0.13
Late development				
Total number of episodes	9	24	17	0
Average	1.13	3.00	2.13	0

episodes per lesson				
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Table 5 : Looking at the change over time (during a year) for eight Mathematics trainees.

Science Trainees				
	Behaviourist	Constructivist	Social Constructivist	Socio-Cultural
Early development				
Total number of episodes	16	16	9	0
Average episodes per lesson	2.29	2.29	1.29	0
Mid development				
Total number of episodes	14	23	10	0
Average episodes per lesson	2.0	3.29	1.43	0
Late development				
Total number of episodes	8	23	11	1
Average episodes per lesson	1.14	3.29	1.57	0.14

Table 6 : Looking at the change over time (during a year) for six Science trainees.

Table 7 below is data collected from trainees-in-action at the end of their training year. It indicates that trainees' lesson plans appear to under estimate the number of times they collectively involve the class in reviewing or reflecting on ideas or suggestions arising during the lesson. It appeared from the video scrutiny that perhaps, due to developing experience or confidence, the beginning teachers more regularly just pause (maybe even subconsciously carry out a mini-plenary) and ask the whole class what they thought of something or some-one's suggestion idea or findings. It is a pedagogic tactic to 'round-up' everyone and the work done so far, and can give a little extra time to those lagging behind a little.

	Behaviourist	Constructivist	Social Constructivist	Socio-Cultural
English				
Planned	2	3	2	0

episodes				
Enacted episodes	3	5	4	0
Mathematics				
Planned episodes	3	4	0	0
Enacted episodes	6	5	3	0
Science				
Planned episodes	2	4	3	0
Enacted episodes	3	4	4	0

Table 7 : Comparing the three video recordings of an English, mathematics and science trainees' lessons.

The direct triangulation of plans and enactments, even though only three trainees, indicate that plans do not always reflect the reality of exact happenings in classrooms, but that it is not unreasonable to scrutinise plans to ascertain trainees' general pedagogic intentions.

Implications of the project

That subject disciplines appear to naturalistically influence the ways that beginning teachers plan for, and enact, their support and guidance for learning.

That English, mathematics and science trainees differ in the ways they plan for different types of learning.

That developing pedagogues are not always cognizant of the lack of inclusive approaches they employ in their classrooms.

That the diagnostic tool developed and applied here that might be useful for trainees to reflectively review their teaching plans and/or their practice.

Although this project involved postgraduates involved in the traditional PGCE, the diagnostic tool could be used with Bachelor of Education (B Ed), Post Compulsory Education (PCE) and any Employment Based Initial Teacher Training (EBITT) route trainees.

It may be useful to use this tool, towards the end of the teaching practice or when trainees find they have challenging classes that are difficult to control (often, but not always) due to a lack of involvement in the learning activities). There may also be mileage in the tool being applied to support and inform development of reflective practice of Newly Qualified Teachers (NQTs) too.

References

Deng, Z. (2007) Transforming the subject matter : Examining the intellectual roots of Pedagogical Content Knowledge. *Curriculum Inquiry* 37 (3) 279 - 295

McGregor, D. (2007) *Developing Thinking Developing Learning. A thinking skills guide for education*. Maidenhead : Open University Press

Project Impact

Short term

- The PGCE MA module Subject Specific Pedagogy (SSP) to be up-dated and informed by the outcomes of the project. This will impact by developing both staff and student views of learning theory and its application to practice.
- Inclusion of Learning Theory more prominently in the trainees programme.
- Dissemination at University Research Conference.

Long term

- Inform practice more widely across our teacher training programmes and not just in the traditional PGCE.
- Engage HEI staff at the University more deeply in theories of and about Learning.
- Involve HEI staff at the University in applying theory to inform practice and visa versa.
- Dissemination at BERA 2012.
- Inform 'next steps' in Pedagogy development research project which will involve a range of ITE staff and potentially more students.
- Inform planned publications in journals and books by McGregor, Dunne, Rickhuss & Taylor.

3. Outputs

The outputs so far are three video recordings (from English, Mathematics and Science) trainees that can be used for teaching about the theory of learning. The lesson planning materials and observational frameworks will also provide further teaching materials for post-graduate education students.

This report will be shared amongst a variety of subject discipline staff to augment discussion about their own teaching, as well as the trainees. Several PGCE staff have also begun to use this approach to inform their preparation of trainees for school placements.

There are lectures now in place (on various teacher training routes) that share the role that *Learning theory* might have for them in development of their practice.

4. Details of any future planned dissemination activities

The project team are planning to present their findings at the School of Education Research Conference, at the University of Wolverhampton, in May 2011.

There are on-going discussions planned that are informed by the research methodology and findings that feed into the “developing Pedagogy Research Cluster” meetings.

The findings have informed developments around the M level action research that post-graduate trainees have to complete at the University of Wolverhampton.

It is intended that the project will be built upon and extended into additional subject disciplines to explore further the notions of curricular influence on developing pedagogy.

The team are also planning to present their findings at BERA 2012. Although originally envisaged that the team would present at BERA in 2011, with knock-on pressures from the OfSTED inspection last year, this is now planned for 2012. From this presentation a paper will be written for the International Journal of Teacher development.

5. Expenditure profile – submitted to ESCalate

6. A 300 word (approx) summary in journalistic style – suitable for the ESCalate Newsletter or Bulletin

This study compares the pedagogic strategies that beginning teachers in English, mathematics and science plan to enact.

The project set out to scrutinise, through trainee’s lesson planning and tutors observations, how beginning educators conceptualised their teaching.

The findings indicate there is a difference in the ways they intend learning to arise.

As anticipated beginning English teachers appeared to organise and manage earlier in their development for social constructivist learning than the mathematics and science trainees.

Mathematics and science trainees planned for predominantly more constructivist learning, by asking challenging questions or inviting interpretations of data about something the pupils have been shown, or requesting an application of a principle to a different context.....all to be done individually.

Interestingly, though, two mathematics and science trainees paid attention to socio-cultural aspects of learning towards the end of their teaching practice.

This indicated they were beginning to reflect about how to design learning to be more inclusive and engaging for *all* the class and not just the majority.

There are general indications that strategies of most beginning teachers generally develop to nurture and support more socially interactive learning towards the end of the first training year.

The implications of this are that beginning pedagogues and their tutors could find it useful to apply the analytical learning theory framework developed through this project. Application of this diagnostic tool can help learner teachers (and their mentors) assess the extent to which they intend (and enact) particular kinds of learning. It is possible to scrutinise plans and

teaching (in-action) using the framework to discern whether learning is behavioural, constructivist, socially constructivist or socio-cultural in nature. This could be a useful tool to help developing pedagogues appreciate whether they are being socially inclusive (or not) in their practice.