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A collaborative action research project to support Mathematics and Science PGCE students with Masters level writing

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Abstract

Since 2005, Post Graduate Certificate in Education (PGCE) courses in England and Wales have been awarded at Masters level which requires students to be able to write reflectively in an academic style in the discipline of Social Science. We have found that the majority of Mathematics and Science PGCE students rarely experience this style of academic writing in their undergraduate studies. This can put them at a disadvantage compared to other students.

The project reported in this paper set out to develop the skill of academic writing of Mathematics and Science PGCE students. The first part of this collaborative study focused on peer-assessment of a synopsis for the second assignment with an emphasis on learning conversations. The effectiveness of this teaching strategy and other forms of support such as formative feedback of the first assignment and discussing exemplar assignments were analysed.

The survey responses and questionnaires revealed that the students valued the forms of support offered. A small percentage of students, however, reported that they found the peer assessments less helpful and preferred more tutor feedback. This appears to indicate that students would benefit from developing better skills for self-assessment and peer-assessment to make learning conversations more productive.

Keywords

Post Graduate Certificate of Education (PGCE); Peer assessment; Academic writing; Masters Level; learning conversations; collaboration

Introduction

In January 2009 we embarked on a collaborative research project to develop strategies to support our students with academic writing at Masters level. This is in response to changes in the Post Graduate Certificate in Education (PGCE) which now must show evidence of study at Masters Level (Jackson and Eady, 2008). This came about due to the Bologna Declaration on the European space for Higher Education (Bologna Agreement, 1999) where 29 countries pledged to reform their Higher Education systems in a convergent way. They concluded that there should be a system essentially based on two main cycles, undergraduate and graduate. The second cycle should lead to the Masters and/or Doctorate degree as in many European countries. Subsequently, the National Framework for Higher Education Qualifications in England, Wales and Northern Ireland (FHEQ, 2001) stated that any postgraduate award must show evidence of study at Masters level. This was followed by the Labour government publishing the intention for teaching to become a Masters profession (DCSF, 2007).

The Masters level component of the PGCE at the University of Leicester is comprised of two assignments, each worth 30 credits towards a Masters Degree. We consider that developing the Masters level skills of reflection on classroom practice is important for teachers' professional development. Practitioners who are knowledgeable in the area of good professional practice and who are also up to date with current research are in a better position to continually update and improve their skills (Harrison, 2008). The Masters level qualification may also serve to enhance the confidence and standing of the teaching profession (Jackson and Eady, 2008).

When undertaking Masters level PGCE work, the majority of Mathematics and Science students are often at a disadvantage compared to other students who come with degrees in English, the Humanities or Social Science. The former rarely experience academic writing in the realm of Social Science in their undergraduate studies. This was confirmed for us by the results of the 2007-8 cohort of students (the first year of the Masters level PGCE in our institution) which showed that a smaller proportion of Mathematics and Science PGCE

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students gained Masters level credits compared to the cohort as a whole (Tas and Forsythe, 2010). To address this problem, in the academic year 2008-9 we implemented a programme of support for Masters level writing aimed at the Secondary Mathematics and Science PGCE students in our institution. Support in place for the whole cohort included whole course sessions on academic writing and helpful documents on the virtual learning environment, including checklists and the Harvard referencing system.

The additional support we offered the Mathematics and Science students was a peer assessment exercise of a synopsis they were required to write as preparation for their second assignment. The Mathematics students also had to write a practice assignment at the beginning of the course, before they wrote their first assignment. This was marked formatively by the tutor. At the end of this year the percentage increase of Mathematics and Science students who gained Masters level PGCE compared to the previous year was 44% (Tas and Forsythe, 2010). We were very pleased with this but set our sights on supporting 100% of our students achieving Masters level (even if somewhat ambitious). In this paper the support strategies for 2009-2010 will be explained and the students' perceptions of these forms of support analysed. We will also include students' ideas for improvement and the implications for further practice.

Support Strategies

For 2009-10 we devised a new set of interventions which included more support for University Assignment 1 (UA1) and continued with the peer assessment of the synopsis for University Assignment 2 (UA2). At the same time the support in place for the whole PGCE cohort had been increased to include practical sessions looking at academic papers, a handbook to support the writing of assignments and optional sessions on doing classroom based research and literature searches.

Taking the view that it would be difficult to try to implement too many forms of support we decided to trial different strategies for the Mathematics and

Science students for UA1 and repeated the intervention as the year before for UA2 (see Table 1. below).

Support for Mathematics students for UA1:	Support for Science students for UA1:
Subject session on writing the practice assignment, looking at the Harvard style of referencing and introducing the mark scheme	Critical Review Library session
Writing the practice assignment	Session on structuring assignment and marking exemplar assignments and writing level descriptors developed from the mark scheme
Peer marking the practice assignment of another student using the mark scheme	Twilight session with tutor in December
Peer conversation following on from the peer marking	Session with (university student support personnel) individual and/or group work
University tutor feedback on the practice assignment	
The peer conversations about the assignment in the session on Monday 12 th December	
Support for both Mathematics and Science students for UA2: Peer assessment of the synopsis for the second assignment	

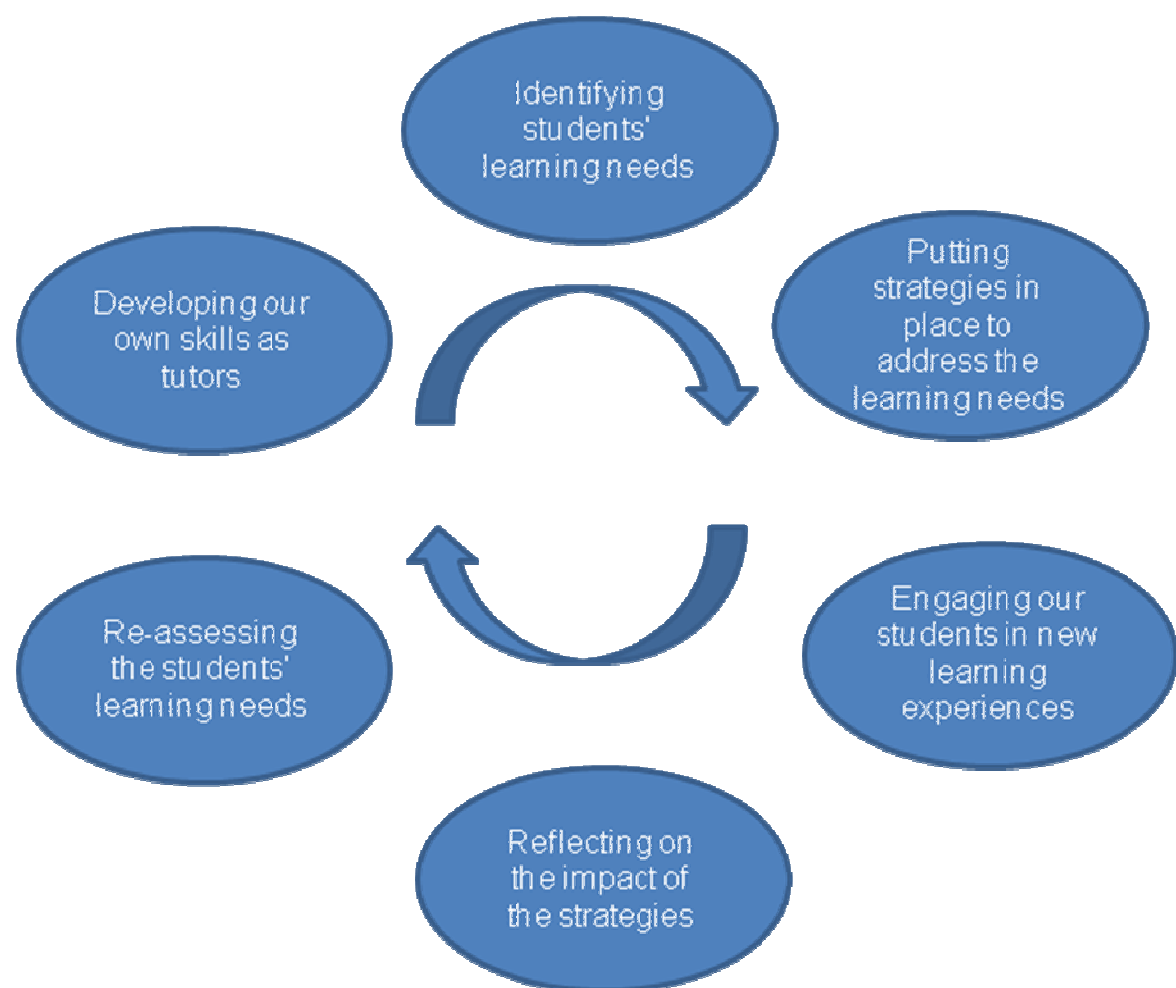
Table 1. Extra support strategies for Mathematics and Science PGCE students in 2009-2010.

Specifically the support for the Mathematics students entailed the writing and peer marking of a practice assignment. The support for the Science students took the form of marking an exemplar assignment using the marking criteria and writing level descriptors from the mark scheme. This was intended to help the students understand what Masters level writing looks like and how to recognise it when they see it in their own and their peers' work. Working with the mark scheme and level descriptors enables the students to understand the criteria for writing at Master level (Rust et al. 2003). Therefore the main strategies chosen to support our students in writing at Masters level are through peer supported feedback of their practice assignments and the synopses of their University assignments. A focus on peer and self assessment can be shown to allow students to reflect on their learning, itself a valuable skill (Black, 1998). Students can learn much through the process of

peer assessment which may lead to them becoming more active learners and having a better awareness of the strengths and weaknesses of their own work (Topping et al. 2000, Sluijsmans et al. 2003, Minjeong, 2009). The peer assessment exercise can also help to develop interpersonal skills such as negotiation and communication, essential skills for the classroom teacher (Topping et al. 2000).

This project is part of an ongoing collaboration between the Mathematics and Science PGCE tutors. Alongside the objective of improving the students' writing skills we wish to develop our theoretical and practical understanding of the use of peer support.

Figure 1. Action research model based on Teacher inquiry and knowledge-building cycles to promote valued student outcomes (Timperley et al. 2007).



The action research model we are using (Figure 1.) is based on the cycle of development of teacher enquiry and knowledge building as described by Timperley et al. (2007). Although this model has been devised for continuous professional development in schools it is useful for us as teacher educators. It describes how we identify students' learning needs, the strategies we put in place to address this, our engagement in developing our own skills, engagement of our student teachers in their new learning experiences, reflection on the impact, and reassessing the students' learning needs for further action.

Methods

The methodology is mainly action research in that we set out to change the situation being studied with the commitment to effective practice (Lomax, 2002). The study used a mixed methods approach which, as Thomas (2009) points out, is appropriate when different elements of the research need different methodological responses. On one hand we needed to study the pass rates for Masters level PGCE over the time frame of the research project (quantitative data) in order to gauge the success of the interventions. On the other hand an interpretative approach was taken to investigate the students' perceptions on the support given using questionnaires and interviews. We wished to know which support was helpful to them and what other support they would have liked. The questionnaires were given to all students after they had submitted each of their assignments. The questions for the first assignment were different for the Mathematics and Science Students and were based on the different forms of support they had received. Both groups of students were given the opportunity to write comments. After the second assignment had been handed in, a smaller group of students were interviewed in pairs.

For the purpose of comparing the students' perceptions of the peer-assessment of the synopsis for UA2 the questions in the questionnaire on support for UA2 were the same as those used in the previous year. The questions were based on the items in the recording sheet used for assessment of the synopsis: concentrating on the focus; questions addressed; Forsythe, S. and Tas, M.(2010) 'A collaborative action research project to support Mathematics and Science PGCE students with Masters level writing' *Teian Journal* 1(2) December [Online]. Available at: <http://bit.ly/tyfJ5M> (Accessed 28 October 2011).

teaching and learning strategies; sources of literature. There were two parts of the questionnaire, to establish the perception of the verbal and written feedback by peers and the tutors separately.

For the semi-structured interviews the following questions were chosen: What did you do to prepare for the first assignment? What have you done differently for your second assignment? What support has been most useful and why? What extra support can you suggest? Do you intend to complete the Masters qualification? These questions were asked to give students an opportunity to talk about their experiences. We also hoped to draw from common elements that we could analyse in conjunction with the questionnaire, and also improve this action research in the future. Four Mathematics students volunteered to be interviewed (2 male, 2 female) and six Science students (2 male, 4 female).

Students' perceptions: results from the questionnaires

In Table 2. overleaf, the results of the questionnaire on perception of support for UA1 in Mathematics are set out. The students indicated that they valued the subject session on how to write the practice assignment, writing the practice assignment itself and the peer assessment of the practice assignment using the mark scheme. The university tutor feedback on the practice assignment was also rated highly. The peer conversations about UA1 which took place just before the reading week were rated helpful by only 50% of the students in contrast with the help from the university tutor which was rated positively by 90%. Several issues were raised in the comments section of the questionnaires: for example, more advice was requested on how to structure the assignment and on locating literature.

	Essential	Helpful	Not helpful (meaning neutral)	Definitely unhelpful
Subject session on writing the assignment	13	14	2	0
Writing the practice assignment	13	14	2	0
Whole course session on writing the assignment	1	10	18	0
Seeing the marking scheme	6	21	2	0
Marking the practice assignment of another student	1	21	6	1
Getting oral feedback from another student on your practice assignment	4	14	8	3
University tutor feedback on the practice assignment	15	11	2	1
Example of how to do referencing document on VLE	8	12	8	1
Checklist for writing assignments on VLE	6	18	5	0
Exemplar assignments on VLE	3	17	8	2
The peer conversations about the assignment just before the reading week	1	14	13	1
Help from co-tutor in school	1	12	14	2
Help from university tutor	6	20	3	0

Table 2. Results of the questionnaire on perception of support for UA1 in Mathematics.

In Table 3. overleaf, the results of the questionnaire on perception of support for UA1 in Science are set out. The session on structuring the assignment and marking exemplar assignments using level descriptors was rated helpful by all students who filled in the questionnaire (n=37). The optional session on assignment writing provided by the student support service was rated very positively by all students who chose to attend (n=11). The session run by the library staff on how to use the electronic library to search for literature was valued positively but some students commented that they already knew how to use this facility having just graduated at Leicester University the year before. All science students valued the individual support from the tutor and a high proportion valued the twilight session to discuss issues with the whole group.

Issues raised in the comments section of the questionnaire included a request for extra tutorials in small groups, the chance to mark more exemplar assignments using the marking criteria and level descriptors and the opportunity to read the work of their peers. A number of students suggested that peer marking a practice assignment was a good idea.

	Essential	Helpful	Not helpful (meaning neutral)	Definitely unhelpful
Whole course session 1 Research/writing at M-level	3	16	18	0
Whole course session 2 in mixed groups	4	13	20	0
Critical Review Library session	8	19	10	0
Session on structuring assignment and marking exemplar assignments using level descriptors	11	26	0	0
Twilight session	4	27	6	0
Session with Student support staff (individual and/or group work)	4	7	0	0
Exemplar Assignments and other info on VLE	6	27	4	0
Handbook for Writing Assignments	12	20	3	2
Individual support from tutor	16	19	0	0

Table 3. Results of questionnaire on perception of support for UA1 in Science.

Given below is a sample of the extra comments written at the bottom of the questionnaire on the support for UA1:

- Library session very helpful in accessing journals
- Session by Student support staff was very helpful
- Level descriptors very helpful, gave an idea of what the assignment should be like
- Twilight session; good to know others were in the same boat
- Structuring assignments session gave an idea of what was needed for each level and how the assignment should be written
- Some kind of feedback on draft assignment would be helpful
- One-on-one very useful, but needed more
- Structuring assignment: this was useful, as it allowed us to review other reports and discuss it with peers

Overall, for both the Mathematics and Science groups, the peer assessment exercise on the synopsis of UA2 was considered to be a valuable exercise, as can be seen from Table 4. below and Table 5. overleaf. Both peer support and tutor support were highly valued with most students commenting that the two forms of support agreed or complemented each other. Table 6. (see p.13) shows again, that a high number of students thought the peer assessment exercise would be improved by more input from the tutor. On the other hand more discussion with peers was requested as well.

Headings for peer assessment form	2008-9 n=33 2009-10 n=41	Gave me new good ideas	Gave me new ideas and confirmed my own ideas	Only confirmed my own ideas	Gave a mix of helpful and useless ideas	Gave me no help at all
Percentage to nearest whole number (%)						
Concentrating on the focus of your assignment	2008-9 2009-10	3 15	61 44	18 27	15 10	3 0
Posing questions that will be addressed in your assignment	2008-9 2009-10	15 5	55 41	21 29	9 20	0 5
Thinking of teaching and learning strategies to try out	2008-9 2009-10	12 0	42 29	24 24	9 24	12 22
Finding sources of literature	2008-9 2009-10	15 10	24 27	27 24	12 7	18 32
					YES	NO
	Was this feedback worthwhile in your opinion?		2008-10 2009-11		85 80	15 20

Table 4. Results of questionnaire on peer feedback on the synopsis for UA2.

Headings for peer assessment form	2008-9 n=33 2009-10 n=41	Gave me new good ideas	Gave me new ideas and confirmed my own ideas	Only confirmed my own ideas	Gave a mix of helpful and useless ideas	Gave me no help at all
Percentage to nearest whole number (%)						
Concentrating on the focus of your assignment	2008-9 2009-10	27 12	49 39	15 34	6 10	3 5
Posing questions that will be addressed in your assignment	2008-9 2009-10	30 10	49 41	15 27	3 7	3 15
Thinking of teaching and learning strategies to try out	2008-9 2009-10	18 7	58 29	12 34	6 10	6 20
Finding sources of literature	2008-9 2009-10	15 7	42 34	30 34	12 10	3 15

			YES	NO
	Was this feedback worthwhile in your opinion?	2008-9 2009-10	88 90	12 10

	2008-9 n=33 2009-10 n=41	Agree with each other	Complement each other	Serve to confuse you
Percentage to nearest whole number (%)				
Did the feedback from your peers and from your course tutor:	2008-9 2009-10	18 41	70 56	12 2

Table 5. Results of questionnaire on tutor feedback on the synopsis for UA2.

What improvements to this peer assessment exercise could you suggest?	What other support was useful?	Other comments?
More feedback from course tutor (11)	Supplementary course on writing up research (5)	Didn't like course on writing up research (2)
Help on how to write a synopsis (6)	Material on VLE (4)	Good exercise, very useful (1)
More discussion with more peers (4)	Support from librarian (3)	Blind leading the blind for peer assessment (1)
Peer marking other's work who is working on a similar topic (3)	Brainstorming ideas in an earlier session (2)	Timescale for UA2 is far too short (1)
Longer time given to read and assess synopsis (2)	Time spent on discussion of requirements (2)	It brought the assessment into focus which was useful in planning (1)

Table 6. Comments as written below the questionnaire on peer-support

Students' perceptions: interviews

Four Mathematics and six Science PGCE students were interviewed on the writing of their assignments. They were asked how they prepared for the first assignment, what they did differently to prepare for the second assignment, what support they had valued and what support they would have found helpful.

It was clear from the interviews that the students learnt from their experience of writing the first assignment and put into place what they had learned for the second assignment. Most students decided on their focus much earlier. Having to write the synopsis for the second assignment was considered a helpful exercise because it required the students to focus on their assignment topic and four out of ten students actually mentioned this.

'I thought the synopsis kind of, you know the peer assessment thing, was helpful. Because I knew I had to do it. So I had to think about it and so I had to write something and now I've got something to work from'.

Gathering of evidence for the second assignment (deciding which classes to target with any interventions) happened after deciding on the focus and this was done differently to the first assignment.

'I guess because we had to do our synopsis, erm, and in advance, and choose a topic in advance of going to the school, I got all my literature review done, before going to the school and chose my topic beforehand. Found out as well a lot of literature and I'd done all my review and so I think I am better prepared for UA2 than I was for UA1, cause I am going into it knowing exactly what I want to do'.

Most students also started reading earlier for the second assignment and almost all reported reading more widely.

'In my first assignment I spent, erm, a very large amount of time searching for the literature and when it came to focusing it, as you say, funnelling it down, a lot of it was not going to be used. So I have tried to be very critical in what literature I sort of like zoom in, use that or not, otherwise I discard it at an initial stage'.

The peer assessment exercise (of the synopsis) itself was considered helpful but with reservations. Two students said that the process was only helpful if the peers they were working with had the skills to be able to give good feedback and ideas. In the Mathematics group the students were put into groups with people writing on a similar topic. In the science group the students were allowed to choose who they worked with and most chose to team up with people doing the same topic as them. One science student who did not do this mentioned that they would have preferred to talk to others writing about the same topic.

'Through coincidence I was sitting next to someone on the table who was working on a very similar assignment as I am, so that was very useful'.

Half of the students interviewed commented on the value of the tutor's input. Two out of ten valued the help of the university library staff in finding literature. Two out of six science students valued the marking of exemplar assignments using the mark scheme with level descriptors.

'The thing that I found most useful was when we got the synopsis back off yourself with all sorts of bits that said well yeah this is a really good idea, what about this. And it gave you a lot to think about and it's actually helped me to really structure what I am doing'.

'The one piece of support which was really helpful was I emailed (the librarian) and she sent me an email with some really useful advice on using research databases'.

Three of the students interviewed would have liked more one- to- one tutor support and two would have liked the opportunity for unstructured discussion with their peers.

'I think more one-on-one tutorials. More getting into groups, with people that you are comfortable working with and sharing ideas'.

'Maybe another session again with peer reviewing your synopsis or even your ideas, come up with more ideas for your assignment. And the group, your small group of four or five sort of, focus your title even more'.

Discussion

Comparing the number of students achieving Masters (see Table 7. overleaf) it seems clear that the interventions had a positive effect, particularly in Mathematics. In the 2007-8 cohort less than half of the Mathematics PGCE students gained PGCE at Masters level but in the 2009-10 cohort all of them did so. Clearly, cohorts of students can differ each year but we view these figures as showing evidence that our intervention has been successful.

Subject	No. of students achieving Masters		
	2007-2008	2008-2009	2009-2010
All secondary PGCE subjects	126/152 (83%)	131/142 (92%)	142/163 (87%)
Mathematics	5/11 (45%)	14/19 (74%)	24/24 (100%)
Science	22/38 (59%)	28/34 (82%)	33/40 (83%) UA1 40/41 (98%)

Table 7. The number of students achieving Masters from 2007-10.

Since the PGCE course is very intense with not much time available for teaching our students how to write an academic assignment at Masters level, we consider that it is important to encourage them to learn how to support themselves and each other right from the beginning of the course. From the questionnaires and interviews it was clear, however, that many students do not feel confident about being peer supporters, or with the support offered to them from their peers. They naturally feel more confident accepting the feedback from their university tutors. This confirms studies by Segers and Dochy (2001) and Lindblom-Ylänne et al. (2006) who reported that students found it difficult to be critical when assessing the essay of a peer. For peer assessment to be a valuable exercise it must be carried out effectively. It is important that tutors offer guidance by making the assessment criteria explicit (Rust et al. 2003; Lindblom-Ylänne et al. 2006). The tutors' and students' understandings of grade descriptors needs to be discussed and a consensus reached (Elwood and Klenowski, 2002; Vickerman, 2009).

Orsmond et al. (2000) argue that even good instructions are not enough to tease out the differences in ways students and teachers understand assessment criteria. However, peer marking and tutor marking of exemplars

result in a better understanding of assessment criteria and subject standards (Orsmond et al. 2002).

Many students feel nervous of making judgements about the work of a fellow student (Hanrahan and Isaacs, 2001). In our research we also found that the students placed more value on judgements made by their tutors rather than their peers. This would indicate that the students do not yet have sufficient confidence in their own and their peers' ability to offer feedback and advice on their academic writing. We realise that this needs to be addressed in the next stage of our research.

We consider that peer assessment is valuable for the purpose of developing the skills of assessor and assessee and that our next step should be to support our students in developing good peer assessment skills. Assessment is no longer simply regarded as a summing up of students' achievements at the end of the course. Rather it is part of the learning process which involves the students themselves being aware of what they need to aim for and what development is needed to achieve this (Sluijsmans et al. 2003).

Conclusions and future work

The quantitative analysis of the numbers of students gaining Masters level PGCE for the cohorts 2007-8, 2008-9 and 2009-10 shows an increase (see Table 8. p.16) and we have taken this as an indication that the support offered to our students has been effective.

The majority of students value the individual support of the tutor, while there seems to be less confidence in peer support. We feel that the students may need more training for being peer assessors than we have given them. Some of the comments on the questionnaires and the interviews flagged up that the process is only helpful if the individuals taking part give good quality feedback and suggestions on how to move forward. Some commented that they trust the opinion of the tutor more and do not feel confident about the feedback from their peers. Therefore to obtain the maximum advantage from the process the students need to be supported and taught how to use peer

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assessment effectively. This will also be of great benefit when they are teaching in the classroom in that they can pass on the skills to their pupils, since peer assessment is considered to be an effective learning experience for school children as well. As Black (1998) points out; students need to be trained in self assessment in order to understand what they need to do (to write at the required level) and how they can achieve this.

Although the term 'learning conversation' has been used by the tutors in the process of the 'peer assessment', the latter terminology should possibly be avoided because the word 'assessment' may cause some students to be anxious. Assessment often implies grades or marks need to be given. For this process only support and progress are important. From informal conversations with students it was clear that they did not want to give each other grades. Therefore we have decided to call the process a 'learning conversation' in the future and the students participating will be known as 'critical partners'.

We have learnt a lot from our work with the students and have devised a new programme of support for the coming year (2010-11):

- In the first instance the preliminary assignment, carried out on the primary placement at the beginning of the course will be used to diagnose the ability of each student to write and to reflect critically. The students will be informed that this will happen to give them the chance to show a good piece of work.
- We will combine the best methods of support used with the Mathematics students and the Science students to provide one model of support. One subject session will address the structure of the assignment, the Harvard system of referencing and the marking criteria. The students will then be given exemplar assignments to mark using level descriptors (and make comments) in groups. The plenary will be a discussion on the marks given and the comments made.
- Homework will be given to produce a short practice assignment using references for literature previously discussed in class plus

one more reference they find themselves. This will be followed by a session where each student reads and gives feedback on a peer's assignment and having a learning conversation in a pair. The assignments will then be given to the tutor to read and to diagnose any student who may need extra individual support.

- For the reading week the students will be asked to provide a synopsis of their UA1 for learning conversations in a group session. Extra tutorial support will be offered to individuals who need this.
- For UA2 we will continue with the peer assessment of the synopsis but will give an opportunity for 'structured' and 'unstructured' learning conversations and focus on the notion that this exercise is not to give feedback but to feed forward. As already noted our students need some teaching on how to give feedback (and 'feed forward') that will support their peers. The learning conversations will only be valuable if the comments are of good quality and appropriate. This will inform the next stage of our collaborative action research project.

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