

## Does Reflective Writing in the PDP Improve Science and Engineering Students' Learning?

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### Introduction

Science and engineering students are often considered as lacking in reflective writing skills. Some commentators have proposed an approach based on Personal Development Planning as a means of enhancement.

This paper describes a study of first-year undergraduate students on computing courses at London Metropolitan University (LondonMet). The study focuses on analysing students' writing in their Personal Development Portfolios (PDPs) using textual analysis to identify categories of reflective writing, based on the work of *Jenny Moon (2004)* and others.

The textual analysis includes an inter-rater comparison tool to verify the placement of extracts into one of four categories described by Moon as descriptive writing, descriptive reflection, dialogic reflection and critical reflection. We hope to identify tasks and structures of support that will encourage reflective writing skills with outcomes that might influence teaching strategy, learning object design and the process of assessment.

### Context

Like many universities, LondonMet has embedded the PDP within the undergraduate programme. For some students, it is hoped the process of reflection embedded in the PDP – as evidenced by examples of reflective writing - will improve their approach to learning, achievement and employability.

For science and engineering students at LondonMet in particular, there may be additional reasons for encouraging reflective writing: the non-traditional educational background of the majority of our students; evidence of plagiarism; a poor record of completing final year projects; and the technical nature of the subject precluding opportunities for reflective writing.

There is evidence that students in some science and engineering subjects in general lack some of these skills. King (2002) cites evidence in computer science:

*“In a culture of increasing emphasis on critical reflection by students, it is not surprising that the external examiners... have looked for evidence of this in student dissertations and other assessments. Towards the end of 2000 it became apparent that the incidence and quality of reflective writing by computing students across all programmes needed to be improved.”*

Similar anecdotal evidence was sought in a straw poll of science lecturers at LondonMet in Spring 2007. Example replies included:

*“We certainly find that students need time to develop this ability [to write reflectively]... They tend to produce very factual pieces of work and lack the ability to weigh up arguments... Workshops would certainly help.”*

*“...weaker students struggle with the level of critical/analytical report writing that they should be achieving.”*

*“Science students find it hard to write reflectively... PDP writing helps them develop these skills.”*

There are many arguments for the benefits of developing reflective writing skills. Page (2005) argues that, as a ‘transition community’, HE students must assimilate a ‘boundary discourse’ and re-align their worldview with that of UK HE: arguing that the process of reflective writing in their PDPs can achieve this.

Hinett (2003) describes good reflection as *“...about maximising deep and minimising surface approaches to learning... about drawing on life experiences... how they learn”*.

Norton et al (2004) argue that one-to-one discussion on a learning inventory between student and tutor is useful and can be used as a predictor for future performance. Thus, there needs to be *“...an investigation of whether writing for PDP purposes is improving self-reflection towards self-development (and thus indirectly, better performance), i.e. the focus is on writing as a tool for constructive reflection”* (Digby Warren, private communication, 27/9/06).

### **Research methodology**

This study uses an ethnographic, grounded analysis style approach to the analysis of documents (the PDP and related assignments) to identify and rate the key terms in the reflective writing practice appropriate to the subject area.

Computing students were asked to volunteer for the project, with guaranteed anonymity and provision of feedback on their reflective writing skills and how to improve them – so that we did not identify any weaknesses without attempting to assist the student (see Norton et al’s comment on the need for this ethical dimension to action research).

We started by asking what it was we were looking for:

*“A definition of reflective writing (see Jenny Moon’s book on Reflection in HE) is needed to identify those students who are doing it. Reflective writing must somehow objectify and externalise the Self in order to assess it against criteria. The ‘key terms’ need to be made clear. Ethnography might need to be complemented by a linguistic analysis or linguistic definition.”*

(Thanks to Adrian Page, private communication, for this paragraph).

An approach to the textual analysis illustrated in King (2002) is suitable for adaptation to this project. Essentially, this project consisted of grading examples of writing in learning journals. A combination of qualitative and quantitative data analysis, similar to Norton et al (2004), was used to measure the relationship between the depth and extent of reflective writing and student performance. Performance was measured in a similar way to that used by Norton et al (2004), i.e. the average module mark.

We hope to use the research to inform learning and teaching practice in a wide range of areas, not only science and engineering. For example, we will explore the possibility of producing an additional tool (similar to the RLO-CETL reflective writing learning object) for assisting students to write reflectively in the PDP if there is a sufficiently clear model emerging from the research (cf Moon, 2004).

### **Defining reflective writing**

Moon (2004) cites the evaluative tool of Hatton and Smith (1995) as a useful method for categorising levels of reflection:

1. “Descriptive writing: This is a description of events or literature reports. There is no discussion beyond description.
2. Descriptive reflection: ... some evidence of deeper consideration in relatively descriptive language. There is no real evidence of the notion of alternative viewpoints in use.
3. Dialogic reflection: ... a ‘stepping back’ from the events. There is consideration of the qualities of judgements and of possible alternatives for explaining and hypothesising... analytical or integrative, linking factors and perspectives.
4. Critical reflection: ... aware that the same actions and events may be seen in different contexts with different explanations associated with the contexts.”  
(Moon, 2004:75)

We adopted this as a means of giving a quantitative value to a qualitative analysis of the writing in the PDPs of two groups of computing students during Spring 2006 and Spring 2007 (their first semester in each case).

The students were taking the first year, first semester Higher Education Orientation (HEO) module ‘Computing Abstraction and Skills’ in which they had to keep a log,

carry out a piece of group research, and write an individual essay.

The two authors identified several writing tasks and independently rated the writing on a scale from 1 to 4 according to the above criteria.

Below are two examples, rated at levels 1 and 2.5. Originally we planned to use only the whole numbers 1, 2, 3, 4 but we found many examples of writing that exhibited elements of greater reflection, but did not justify a full elevation to the next level. We met and agreed to use 0.5 steps as the best way of describing these examples. The additional variation in the data also helps to produce more meaningful statistics.

*Figure 1: an example of reflective writing at level 1*

Mo and my group discussed on how to take notes and what is the best way they prefer to take notes.  
I personally said I prefer taking notes by writing down the most essential and important points down and writing them down in a way I can understand when reading and revising.

The authors both agreed a rating of level 1 ('descriptive writing') for the example in Figure 1. The student describes his experience of group work but with no evidence of 'alternative viewpoints' suggested by Moon as an indicator of level 2 writing.

*Figure 2: an example of reflective writing at level 2.5*

exchange contacts with them, I was a bit shy because they were all looking so matured (giant, office look). It was also a moment for me to mix up and work with different people of different personalities. I noticed that I am a fun person to be with, but I understand that I have to limit the many jokes I do enjoy and get serious with any task needed to be discussed or attend to. It really wonderful that I am discovering my weaknesses and with the help of group (G-six) I am working out to improve my skills.

After discussion, the authors agreed to rate the example in Figure 2 at level 2.5 as it seems to contain elements of writing at level 2 and at level 3. Alternative viewpoints are given: maturity compared to a 'fun person to be with' and, in addition, at level 3, he is beginning to engage in a dialogue with himself, 'externalising the Self' as Page (2005) put it, or 'mulling about' as Moon describes her own way of identifying dialogic reflection. Neither of us felt he had fully analysed the consequences of his findings, however, hence the rating of 2.5.

## Analysis and preliminary results

In all, seventeen students' writing in their PDPs in Spring 2006 has been analysed thus far. The results of our rating of several examples by each student are shown in Figure 3.

Figure 3 Results from the inter-rating tool (of PDP writing examples)

<i>Inter-rater check</i>			<i>Pete's marking</i>				<i>Dafna's marking</i>						<b>Averages</b>			
<i>Stud</i>	Category of writing													Pete's	Dafna's	
<i>ID</i>	Text number:			Week 5				Week 5								
	w3	Task 1		Task 1				w3	Task 1		Task 1				simple mean	
	1	2	3	1	2	3		1	2	3	1	2	3			
1	1.5	1.5	1	2				1	1	1	1	1			1.5	1.0
2	1	1		2	1	1		1	1		1.5	1	1		1.2	1.1
3	2			1	2	2		1			1	1.5	2		1.8	1.4
4	1			1.5				1							1.3	1.0
5	1	1						1	1						1.0	1.0
6				1.5				1			1				1.5	1.0
7	1			1	1			1			1	1			1.0	1.0
8				1.5	1.0						2.5	1.5			<b>1.3</b>	<b>2.0</b>
9	2.5	1.5		2	1	1.5		2	1.5		1.5	1.5	1		1.7	1.5
10	1			1	1			1			1	1	1		1.0	1.0
11				1	1.5						1	1			1.3	1.0
12	1			1.5	1			2			1.5	1			1.2	1.5
13	1			1	1	1		1			1	1			1.0	1.0
14	1			2	1.5	1.5		1			2	1.5	1.5		1.5	1.5
15				1							2	1			1.0	1.5
16	1			2	1.5	1		1			2	1.5	1		1.4	1.4
17				1.5	1	1.5					1.5	1	2		1.3	1.5
															<b>Correl:</b>	<b>0.3</b>

Up to three writing tasks from week 3 and three from week 5 were analysed for each student, each having 1-5 extracts actually found in their PDP. The questions related to literature research, personal skills and their experience of group work (the last being the subject of the writing in Figures 1 and 2 above).

A total of 52 extracts were analysed and the results were independently agreed in

16 cases. In one case, the one in Figure 2 (or student No.8) we re-viewed the writing and agreed the score of 2.5.

Overall there was a correlation of 0.3 between the lists of averages for each rater, which we believe is strong enough to justify the use of the Moon categories and the inter-rater tool and verify the scoring, although it is not statistically significant. In only one case (student No.8) was the difference between the averages greater than 0.5.

It was disappointing to note that almost all the writing, 83% of the examples, was scored at 1 or 1.5, showing a very low level - descriptive writing only. However, this may have been anticipated from the evidence previously collected. There was, however, some evidence of what Moon calls descriptive reflection (level 2) and dialogic reflection (level 3) although only the Figure 2 example approached level 3.

We reviewed the results from the students' module marks (taking their average) as an indication of student performance to look for correlation with their reflective writing scores. The result is shown in Figure 4. There were 15 students who survived until the third semester of their course and the three sets of module marks were chosen as sufficiently good indication of performance.

Figure 4 Correlation of academic performance with reflective writing score

adj		DH
av		mean
mark		
59		1.0
50		1.1
41		1.4
48		1.0
44		1.0
35		1.0
56		1.0
55		2.0
56		1.5
51		1.0
48		1.5
38		1.0
70		1.5
56		1.4
41		1.5
<i>correl</i>		<b>0.3</b>

Again a correlation of 0.3 was found which indicates a weak, positive relationship but not enough to be significant. One reason could be that so many of the scores are the same, with little differentiation, but clearly more research needs to be done to establish a definite relationship between reflective writing skills and academic performance in science and engineering.

It could be argued that reflective writing is only necessary for a small part of the module assessment, so it is not essential – merely desirable – that science and engineering students write well in order to pass the module assessment. The authors, however, would argue that improved reflective writing ability does lead to improved performance overall but this has to be proved.

In addition, these findings tend to confirm other research in this area, for example about the ability to judge individual examples of writing in isolation:

*“Student writing can be used as evidence for the presence or absence of reflective thinking... [but] Identifying textual elements within journals and allocating them to the finer levels of reflection within a more complex model of reflective thinking was, however, more problematic and considerably less reliable.” (Wong 1995)*

### **Some initial conclusions and future work**

Most science and engineering student's writing in the first semester is at the level of description, with some reflective writing when discussing group work.

Many PDPs paraphrased example ‘reflective’ text as provided in the lecturer’s prompting question (e.g. ‘did you feel shy when you started working in a group?’). There is some confirmation from a similar module’s PDPs in Science, in Human Nutrition, that those students also rarely write beyond basic description. So, is the problem subject, student or task related? There is evidence from other research that reflective writing can be explicitly introduced and taught.

Firstly, the PDPs for another HEO module in the Business School were also analysed by the authors. Tasks there were specifically situated within a reflective writing framework of: ‘What, So what, Now what?’. Lectures, tasks, draft feedback & marking criteria were all related to reflection and critical thinking. Initial cursory analysis showed that there is evidence here of writing to levels 3 and 4 on the Moon scale.

Secondly, in another Computing HEO module, reflective writing is taught explicitly with reference to Kolb, Ramsden, Moon and others (Wilson-Medhurst, 2005: 92). The task requires students to “...relate the material on the module to their own experience”. Formative feedback and group work assessment are two features that were found to ‘work’ in the sense that they encouraged more reflective writing.

Moon (2004: 70) cites Johns’ (1994) work on ‘guided reflection’ and suggests tasks for training professionals; commenting that additional questions are required for ‘critical reflection’ in learning. Can we adapt this approach to teaching and learning in science & engineering? If so, what questions might best guide reflection?

Given this evidence, then, there would seem to exist ways to structure and set tasks

that can develop the skills of reflective writing. Students need to be able to answer questions such as:

- What did I do? (*describe*)
- Why did I do it? (*analyse*)
- What if I did it another way? (*evaluate*)
- How would I act again in another context? (*'How did it affect my assumptions and beliefs?'* (Moon, 2004:70))

Group work tasks and questions seemed to extract the 'best' examples of reflection in the first semester PDPs we analysed, at least – what other tasks might do this? Should they be subject specific, task specific or assignment-related? Our research indicates some questions relating to group work that might elicit answers at level 2 (e.g. 'did you notice different behaviours among the group?') or level 3 (e.g. 'did individual behaviour change, if so how and why; if not, why not?').

The authors are intending to identify and specify learning and teaching tasks with these additional questions above that promote reflective writing: not using 'examples' which often guide students to replicate their pattern.

We are also proposing to assess whether interventions by writing mentors from the *Write Now* CETL, which is sponsoring this research, can make a difference.

Further, we want to produce a guide to lecturers on how to categorise and assess levels of reflective writing (a Moon inter-rater tool?). We also hope to incorporate an additional strategy by designing a reusable learning object incorporating these findings, similar to the RLO-CETL, but specific to science and engineering tasks.

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## **Biographical note**

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