

Implementing Reflective Writing in a Problem-Based Learning Civil Engineering Programme

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Abstract – Some issues of current concern in engineering education are described. The theory, rationale and implementation of reflective practice in educational settings are briefly reviewed. The use of reflective writing in the University of Limerick’s (UL) Problem-Based Learning (PBL) Civil Engineering programme is described.

The habit of ‘reflection’ is embedded in the context of a full scale design-and-construct problem in year two of the programme. Student reflections were captured in learning logs over two successive years. Aids to prepare students for reflective writing are described. Outcomes before and after implementation of the more recent aids are examined. Analyses of these data are presented and discussed. The paper concludes with some proposals for further development.

Key Words – Reflective Practice, Problem Based Learning, Civil Engineering.

I. INTRODUCTION

Learning outcomes documented for professional engineering programmes internationally agree that developing autonomous lifelong learners is essential [1 p. 15, 2 p. 3]. Stakeholders worldwide discern an urgent need for reform to achieve the desired outcomes. Fundamental problems with graduate capability have been identified as long ago as 1977 [3]. Accreditation bodies, industry and educational researchers all agree that traditional lecture based delivery systems in isolated subject streams are not achieving the desired outcomes [4, 5]. A variety of responses to this crisis are evident often including the adoption of various learning-by-doing approaches e.g. Problem Based Learning. Donald Schon highlighted the processes that led to the divergence between the concerns of the academy and professional practitioners [6]. He describes ‘reflection in action’, as fundamental to the world of practice but largely absent from the traditional academy.

The Civil Engineering program at The University of Limerick (Civil @ UL) was built *ab initio* around a PBL methodology. Therefore the work reported here takes place in a PBL context. For an account of the overall strategy see [7]. This paper focuses on one element only of this strategy: reflective writing. The reflections are however, strongly conditioned by the PBL context and the study will, therefore, be of interest to both practitioners and researchers in PBL.

II. DEVELOPING LIFE-LONG LEARNERS

Reflective practice in professional education is now well established, particularly in health and teacher education

programmes. But all professions now agree that the development of autonomous, and therefore reflective lifelong learning is central to modern professional formation. Research supports the contention that metacognition or self-awareness of one’s thinking and learning processes [8] is a necessary aspect of this orientation.

“Reflection can be described as a mindful, metacognitively controlled activity. Mindfulness in learning refers to attentive, volitional and effortful dealing with subject matter ... Empirical findings confirm the relevance of reflection to enhance deep processing [9] and understanding.”[10]

Metacognition, or reflection on one’s learning process, is fundamental to facilitate deep (as opposed to surface) learning [8 p. 7]. Reflective learning logs or diaries are commonly used in health-related and teacher education programmes to develop a reflective orientation in students. Their use in other settings including engineering is rare.

The other two programme components necessary for deep learning are conditionalised knowledge and communities of inquiry (*ibid*). *Conditionalised knowledge* is “knowledge that specifies the contexts in which it is useful” (*ibid*, p.6). PBL is a commonly-used strategy to facilitate such knowledge (*ibid*). *Communities of inquiry* (COIs), also referred to as communities of practice, involve three modes of presence: cognitive, social and teaching presence [11]. Cognitive presence refers to the learner’s ability to progress from the initial stage of inquiry to resolution of the problem (*ibid*). The indicators of cognitive presence (which parallel the PBL process) are:

- Triggering event (typically indicated by a sense of puzzlement and recognition that a problem needs to be solved)
- Exploration (indicated by information exchange and discussion about the nature of the problem)
- Integration (indicated by learners connecting ideas and applying various theories to the problem)
- Resolution (indicated by learners applying new ideas to solve the problem)

The other types of presence needed for a community of inquiry – social and teaching – will be examined in greater detail in future work.

III. REFLECTIVE WRITING IN CIVIL @ UL

Reflective writing was introduced in autumn 2009 when the first cohort of students were entering second year. This decision was influenced by Cowan's work [12] where implementation of reflective writing in a variety of programmes was shown to be measurably effective. Teaching tools, based on established models for reflection [12, 13] have been developed to support the students in their reflective writing.

While reflective writing occurs throughout the programme, this article addresses the output from the 'Steel and Timber Design' module in year two and a following module in 'Hydrology and Water Engineering'. The reflections were assessed using a grading rubric developed from Driscoll's (2007) model. Reflections submitted before and immediately after a reflective writing workshop are compared. In response to the very uneven quality of reflections initially submitted, these tools were developed further. Table I summarises the development and use of these tools. A description of the stages follows the table.

Table I: Preparation for Reflective Writing: Development of Methods

Year	Cohort	Stage	Preparation Method
'09-'10	1	A	1 page guide presented to class
		B	As A + feedback on exemplar student reflections
'10-'11	2	C	As B + exemplar staff reflections
		D	As C + Driscoll's model + Univ. Portsmouth guide + Active reflective writing session + Peer review of reflection + Tutors' model reflection and review
		E	As D + Student assessment of tutors' reflection, using Driscoll's model

A. Stage A:

A one-page guide, which was presented in class, enunciated Cowan's definition of reflective learning:

Learners are reflecting when they analyse or evaluate personal experiences that have a bearing on their learning and attempt to generalise from that thinking. They do this so that in the future they will be better informed or more skilful or more effective than they have been in the past [12].

There followed some suggestive questions to provoke reflection and a specific direction to go beyond narration.

B. Stage B:

Feedback on anonymised extracts from the students' own reflections was provided. Examples of superficial narrative and deep reflection were presented by way of contrast. The students were then asked to confer in groups to assess further sample reflections in the light of the definition and the examples just given. The results suggested that

many of the class did not grasp the distinction between narration and reflection.

C. Stage C:

In addition to the Stage B guidance, the first author shared an extract from a reflective assignment for a staff development programme and another on his experience of teaching the module in question. Demonstrating authenticity to students in regard to reflection is important. Encouraging students to reflect while neglecting to reflect oneself is inconsistent. (The students were amused to hear that a staff member was also subject to reflective writing assignments, electronic submissions and deadlines.)

D. Stage D:

Following a consultation with the Centre for Teaching and Learning at UL we arranged a reflective writing workshop. Driscoll's model for reflection was chosen for its clarity and simplicity (compactly summarised as ***What? So what? Now what?*** [13]). A short reflective writing guide from the University of Portsmouth was also presented. Students and staff who attended the workshop were then invited to prepare a brief reflection on one significant experience from the module. They were then invited (not compelled) to share this with a peer for review. The peer was required to provide feedback using Driscoll's framework. The tutor peer pairs were invited to share the reflections and peer reviews with the class.

E. Stage E:

A further short workshop was arranged during a following module, 'Hydrology and Water Engineering'. One tutor's reflection, prepared as part of diploma coursework, was distributed. The students were asked to read this and review it in groups using Driscoll's framework. As only half the class attended, the opportunity was taken to compare grades of those who attended the workshop with those who did not.

IV. RESULTS FOR STAGES A & B: COHORT 1, YEAR 2

Reflections throughout this year demonstrated a wide variation in quality. Some were narratives with limited reflective content, e.g.:

"I learned how to design a beam"

"I learned about simple v rigid construction"

Others were deeply engaged reflective pieces demonstrating significant metacognitive awareness, e.g.:

"During this module there were a number of things that finally made sense, things now had more of a purpose. I also noticed I take longer to understand some topics and have to go through some topics at a slower pace myself."

"This has made me see that as Engineer's we need to maybe slow down, stop racing into the calc's, spend a little more time weighing up the various scenarios."

"The enthusiasm of one or two in a team can push things on too fast before all the angles of the current issue are exhausted."

Some students used guidance documents we provided as a rigid checklist. Many produced a diary without a reflective examination of experiences. Some produced reflections with themes and phrases closely aligned with the exemplar guidance. Some students included feedback on the programme mixed with the reflection. We acknowledged the usefulness of the feedback, even though it was not the goal of the reflective exercise.

V. RESULTS FOR STAGES C & D: COHORT 2, YEAR 2

The sample size for Stage C was 30 and for stage D was 27. There was an increase in A2 and B1 grades, with a quarter of the class improving by at least a grade. The average percentage mark improved from 54% to 58.4% (see Fig 1).

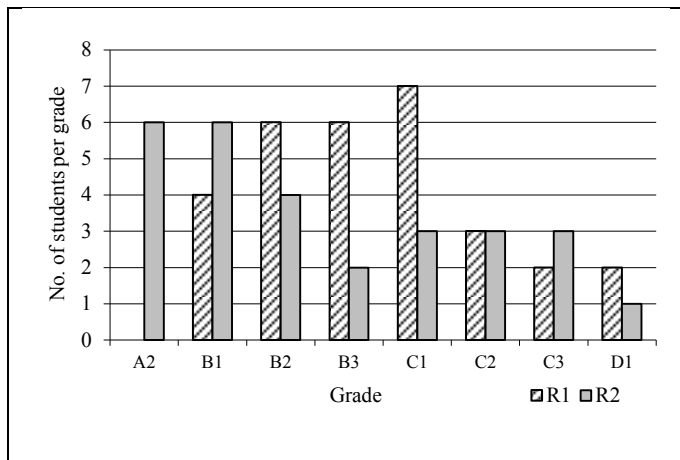


Fig. 1. Reflection Grades

VI. COMPARISON OF GRADES FOR STAGE E: COHORT 2, YEAR 2

Here we are comparing grades for those who attended a further reflective writing workshop in a follow-on module in 'Hydrology and Water Engineering' with those who did not. The mean percentage mark for those who attended was 56% compared to 49% for those who did not attend.

VII. TUTORS' REFLECTIONS

We find as educators that reading students' reflections give us a deep insight into the real struggles, frustrations and successes of our students. Their developing insights, struggles and victories are palpable on the page. The diversity of experience and talent among our students becomes visible. This has a strong positive motivational impact on us. There is a deepening of awareness of the students as persons. In addition, feedback on various aspects of the programme surfaces naturally. This feedback is useful, though not always reflective in character.

VIII. DISCUSSION

Our experience indicates that providing guidance in reflective writing is effective. However persistence is required. We are working to further develop our resources and practice. In future we will not use reflective pieces generated by staff as students seemed quite reluctant to

critique tutors' work. The weaker reflections do not engage with the students' own experiences in a reflective manner. The reasons for this will vary but may include prior unreflective learning-by-rote conditioning, perceived insufficient marks to justify the effort, insufficient skills development in reflective writing, and/or too many reflective writing assignments.

IX. THREE CHALLENGING QUESTIONS

Are we as tutors trustworthy?

Authentic reflection requires a degree of self-revelation and therefore trust in the tutor. Ghaye illustrates the ethical dilemmas and potential negative impact of compulsory reflective writing [14].

Should reflective writing be assessed?

Cowan encountered similar dilemmas to Ghaye and concluded that students' reflective pieces should not be assessed, though he did give feedback which was grounded in a Rogerian praxis of 'unqualified positive regard' [12]. Slattery found that more students maintained reflective journals when they were required to do so, than when reflection was voluntary and did not count towards the final grade.

How can we ensure authenticity?

Student teachers can invent classroom episodes to satisfy the requirement for reflective writing. The first author has himself encountered this phenomenon among postgraduate students in other disciplines. It is fair to say that learning activities in CIVIL@UL do not involve the ongoing affective personal dilemmas that characterise the health and education professions. Therefore the issues noted above may not be quite as intensely felt. We cannot, however, assume they do not exist and we must remain alert and critical in our practice.

X. CONCLUSIONS

Providing guidance in reflective writing improves the quality of students' reflective writing. Teaching and preparing authentic reflective writing takes time. Staff engagement and motivation is enhanced. Feedback on the programme itself often occurs as an ancillary benefit.

XI. FUTURE DEVELOPMENTS

We are preparing exemplar reflective pieces from various disciplines for use in future workshops. Students will critique and assess these pieces individually using the CIVIL @ UL grading rubric and then discuss their results in groups. These will highlight evidence of cognitive and social presence [15] thereby reinforcing the rationale for reflective writing and enhancing engagement.

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