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Using an understanding of feedback processes to improve student learning

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Abstract: The main purpose of this paper is to give some novel insights into the creation and use of feedback within a learning environment. The literature commonly puts all the emphasis for feedback on what staff do, but this paper will demonstrate using analogies with classical control feedback loops that it is in fact not staff who create feedback, but students. Consequently, rather than pressurising staff to create more, faster, better 'feedback' the onus should be on educating students, and staff, on how to create effective feedback from the myriad of information available to them.

Keywords: Feedback, measurement, student engagement, student responsibility, student satisfaction.

1. INTRODUCTION

The issue of feedback has routinely scored relatively poorly on National Student Survey (NSS) results and this despite huge efforts by Universities to address this. In the author's view, the poor student perception of feedback at University is much more down to their misunderstanding of what feedback should be, in effect an assumption that the type of feedback provided at school will continue to be available at University. This paper will give some evidence to support that view and specifically will give an insight into feedback processes which is less well publicised in the mainstream literature. The insights derive from a mathematical analysis of control feedback loops in engineering and these insights are a powerful methodology for showing the impact of different components within learning. The main conjecture of this paper is that University staff would be better putting more effort into helping students understand learning processes (Schaefer et al., 2012) rather than focussing on what students perceive to be poor staff feedback; indeed in many cases the real weakness is the student recognition and inadequate use of feedback (HEA, 2012; Hepplestone et al., 2010) rather than the feedback being poor quality, although of course it is accepted that occasionally staff do provide poor quality feedback.

Recent work has emphasised the need for students to be the prime movers. For example from Winstone and Nash (2015), *The very best feedback is sure to be futile if students do not use it, assimilate it, and implement it in their future goals.* A similar message is given by Brown (2014) and Sivasubramaniam (2014) where it is emphasised that students need to be supported in critiquing their own work, that is generating their own feedback; of course it is implicit that staff provide mechanisms such as online quizzes to help students to do this. A different view on the same message appeared in Benjamin (2012); Wheatley (2012); Wong et al. (2012) where the focus was on distinguishing between feedforward and feedback. The key point is that feedback from staff cannot or will not be utilised effectively by students unless they have an obvious, perhaps immediate, opportunity and motivation to use this for future assignments (Race, 2015). Within the control engineering community this issue has been well understood although again viewed from a different angle. Here there has been a lot of emphasis on game playing and interactive computer tools which encourage students to learn through trial, error, experimentation, reflection and so forth (Khan and Vlacic, 2006; Guzman et al., 2006; Rossiter, 2007, 2013). Again a key point is enabling the student to become active in generating their own feedback. A particularly relevant work in the literature has focussed on so called self-regulating learning (Duffy et al., 2012), whereby students are encouraged to be much more aware of their role in the learning process and the importance of actively reflecting on their own progress, feedback as available and their own needs. It is this thread which is pursued in the current paper.

Another popular tool for encouraging students to become active participants in feedback processes is peer assessment (Hughes, 2007; McConlogue et al., 2010; Orsmond, 2012; Rossiter, 2013b). The aim here is to get students to think deeply about the assessment criteria and the extent to which different pieces of work meet those criteria and to provide comment and justification for their marking. There are twofold benefits in that students receive detailed comments on that work, albeit from peers, and moreover students are emotionally and mentally prepared to think carefully about the quality and weaknesses of their own work given the effort gone into marking a fellow students submission; this should also help them become more targeted in seeking clarifications from academic staff.

A key focus of this paper is the message that feedback comes in many forms (Feedback Toolkit, 2012) and students need to be on the look out and to recognise the feedback when it is available. Too often students think

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they are getting no or poor feedback because they do not recognise the feedback being provided as feedback. It is well understood in the mainstream literature (Evans and Waring, 2011; Geyskens et al., 2012) that feedback comes in many forms, some of which are staff generated and some of which are self-generated (by the learner), but learners do not respond equally or recognise each form of feedback, irrespective of its quality. A key point is the emphasis on active student engagement with the feedback in order for it support learning effectively. One popular method for improving student engagement is regular assessment, for example with small computer based quizzes which provide instantaneous feedback (Arteaga and Vinken, 2013; Cole and Spence, 2012; HELM, 2015; Rossiter et al., 2004). Nevertheless it is interesting to note that based on viewing several years of student feedback questionnaires, many students who have a number of such quizzes on a particular module often do not equate this with having received feedback on their work!

In summary this brief introduction has reviewed some of the literature on feedback and made some key points. Although students and in particular graduating students often perceive feedback as major weakness of their student experience, in fact this perception is more likely underpinned by a lack of recognition and engagement with the feedback that was available, notwithstanding that at times some staff do a poor job of facilitating effective feedback. This paper will use some insights from control engineering and in particular the topic of feedback control loops to give a different insight to this issue and thus demonstrate the criticality of focussing on student perceptions and an understanding of the feedback learning process and how staff can facilitate this.

2. LINKING LEARNING PROCESSES TO FEEDBACK CONTROL DIAGRAMS

In order to make clear links with control feedback diagrams, this section will use a simplified version of the learning process as this leads to many useful insights without claiming that the analogy should be taken to excess.

2.1 Block diagram representation of learning

This paper will approximate learning by a simple iteration between:

- Students reflect on the target learning and their current knowledge/information available.
- Students use their understanding to attempt problems and produce an output (could be a homework, coursework, formative study, etc.).
- Students receive some comment on their output (for example this could be right/wrong or more detailed textual analysis). This is new information which can be used in reflection.

This iteration is represented in figure 1 and ideally is an ongoing or continuous process. Using this form of block diagram representation shows clear analogies with feedback control systems such as that represented in figure 2 where in this case:

- Students reflection is represented by a block diagram $K(s)$ where the input information is the target learning outcomes (represented by $R(s)$) and a comparison with any 'feedback' they have received on their work (the signal $H(s)Y(s)$).
- Students attempt problems and produce an output is represented by system $G(s)$ and output $Y(s)$.
- Students receive comment on their work; this is represented by sensor $H(s)$ scaling the student output $Y(s)$.

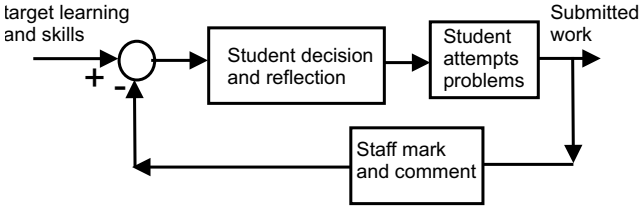

Fig. 1. Simple representation of a feedback learning process with iteration between staff comment, student reflection and student trying problems.

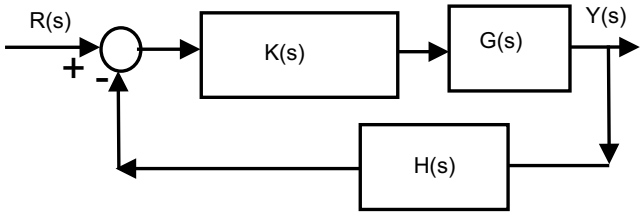

Fig. 2. Equivalent block diagram representation of a feedback learning process with between staff comment $H(s)$, student reflection $K(s)$ and student trying problems $G(s)$.

The main conjecture of this paper is that we can use the analogy of figures (1,2) to gain insights into the learning process and in particular the role or significance of the different components $K(s), G(s), H(s)$, that is the role of student reflection $K(s)$, students attempting problems $G(s)$ and receiving comments on their attempts $H(s)$.

2.2 What makes a feedback loop?

Before we proceed to analyse the analogy above more carefully, it is first worth while rebuffing a common myth about feedback and make a clear statement.

FEEDBACK IS NOT WHAT STAFF DO, IT IS WHAT STUDENTS DO!

The key point is that while staff provide the feedback path, that is measurement or information based on student output, this does not become feedback until it is collected and reflected upon by the student.

Consider figure 3, in this case, it is irrelevant how high quality the comment and measurement provided by staff on student work because the student is not making use of this comment to correct and update future attempts. Consequently, feedback does not exist even though the information to facilitate feedback does! This information cannot become feedback until the student does something with it! Indeed, such an observation underpins the literature which uses the terminology feedforward (Benjamin, 2012) to suggest that feedback information needs to be able to influence future student submissions; in fact this