Feedback: Completing the cycle

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Feedback cycles are useful concepts in biological systems, our everyday lives, and education. However, Higher Education is finding itself in something of a feedback crisis, with low student satisfaction despite high academic workload in this area. Here we explore how changing our conceptions of feedback in Higher Education could address this, and look at some positive cases of innovative feedback practice within bioscience disciplines.

Feedback cycles: in biology and education

Feedback is the process by which output signals from a given system inform or affect the input - creating a cycle or loop. This is commonplace in our everyday lives and inside our own bodies.

For example, our blood sugar is regulated through feedback (Figure 1A). In most healthy people, insulin, glucagon and other biochemical signals act to keep our blood glucose concentration within tight bounds—whether we're running a marathon or relaxing after a big meal. In this case, feedback is used homeostatically to stick to the status quo.

Other feedback cycles amplify an outcome rather than maintain it, such as in platelet blood clotting and contractions during childbirth. Either way, feedback is cyclical in nature, rather than a one-way process or pathway.

Feedback has been adopted as a higher educational concept for a few decades now, but it's become something of a sticking point. Across UK universities, the Assessment and Feedback section of the National Student Survey (NSS) is consistently among the lowest scoring.

Broadly speaking, students claim their feedback is of unsatisfactory quantity or quality. Meanwhile, staff claim the comments they worked hard to produce are largely disregarded.

One potential reason for this disconnect could be a tendency to view teaching as "transmission" from staff to student. In these cases, the educational feedback cycle can become linearized, with an overemphasis on staff rather than student activities (Figure 1B).

If this is true, efforts that solely focus on how feedback is delivered (i.e. by teacher action) rather than on how it is received and used (i.e. by student action) are unlikely to be wholly successful. This is analogous to the disease model of Type II diabetes in blood sugar regulation; there is plenty of insulin (feedback signal) to go around, but the relevant cells aren't able to respond or utilize that signal effectively.

In these cases, simply adding more insulin (i.e. piling on more feedback signal) isn't likely to work as a systemic fix, as it does not address the underlying issue. More careful modulation of the signal and how it is received are more likely to work in the long term.

Feedback myths and nostrums

Molloy and Boud encapsulated four feedback "nostrums" or pseudo-medications which may offer some comfort to those tasked with providing feedback. In reality, these myths may preclude addressing the staff–student disconnect (Figure 2).

Redefining feedback: completing the cycle

So how can we generate a healthier, more productive feedback system which benefits both students and staff? There is a current movement to re-conceptualize what "feedback" means in higher education.

Feedback isn't "done" when information leaves the tutor's mouth, pen or keyboard. It's only genuine feedback if the student accepts, internalizes, processes and uses it as an input to improve future work. As it happens, this reconnects feedback in education with its original meaning: completing the cycle.

Another way of looking at it is to move from viewing feedback as transmission to a more active

dialogue between student and educator. In this model, students learn to seek specific judgement from others, becoming more active participants in their learning journeys. (Figure 1C)

Removing barriers to engagement

This is not easy. The difference between a student and, say, a pancreatic cell is that the student has the capacity for conscious thought and decision. Students, like most people, find feedback cognitively and emotionally draining.

Nash and Winstone note that "most students in higher education have received little or no prior guidance on how to use feedback effectively". They advocate shared responsibility as way of removing various barriers to active engagement with feedback.

This starts with genuine conversations raising awareness of the nature and purpose of feedback in its many forms, and discussing rather than dismissing the very real emotional impact feedback can have. It includes training in how to make use of feedback, rather than assuming that cognisance.

Courses can better offer students the agency to make use of feedback with well-connected assessment tasks aligned to programme-level teaching and learning objectives. This allows students to develop their own sense of volition, so they can adopt a greater share of the responsibility, which currently rests heavily on academics' shoulders. (Figure 3)

Making it work: positive examples

For those who claim students don't engage with feedback, there is plenty of scope for hope. Zimbardi et al used learning analytics to track biomedical students' access times and clickstream (mouse activities) on audio and typed feedback snippets embedded *in situ* to scientific report assignments.

The vast majority accessed their feedback (92% of first year, 85% of second year students) and over half interacted with it for more than an hour. Furthermore, students who interacted with their feedback for longer tended to show more improvement in subsequent similar assessments.

Quality over quantity

There are ways to provide students with opportunities for complete feedback cycles whilst also reducing staff marking burden. In a research-led bioscience module described by Morrell, students completed eight "News and Views" assignments, of which three were electronically annotated with formative
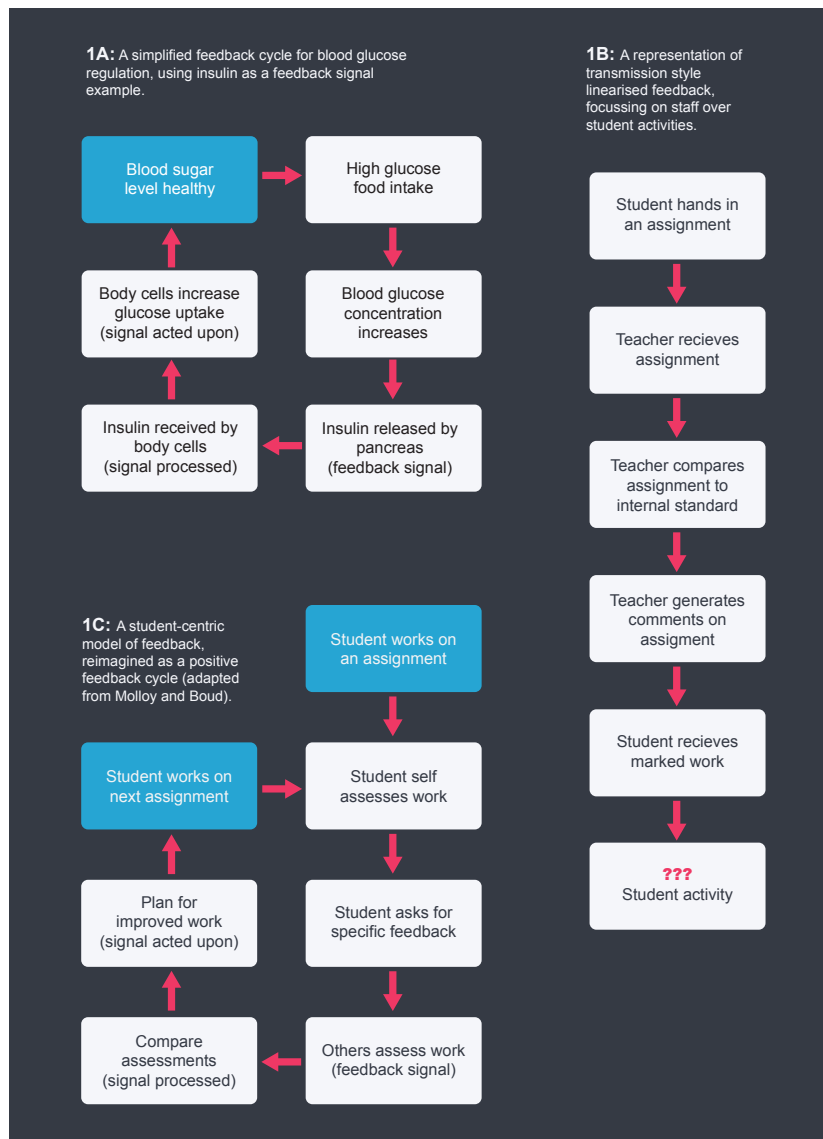

Figure 1. Conceptions of feedback in biology and education. (a) A simplified feedback cycle for blood glucose regulation, using insulin as a feedback signal example. **(b)** A representation of transmission-style linearized feedback, focussing on staff over student activities. **(c)** A student-centric model of feedback, reimagined as a positive feedback cycle (adapted from Molloy and Boud)

feedback. Students also had access to some marked reports of their peers.

At the end of the module, students could select any two of these assignments for summative submission. The majority chose to submit at least one unmarked assignment. Students who chose to submit unmarked assignments scored significantly higher compared to those students who submitted work which had been previously marked. This could be due to students engaging with and using

Nostrum	Reality
1 **All feedback is good feedback**	Overly critical feedback has the power to instil "learned helplessness". By contrast, purely positive comments may lead to complacency. Both can reduce students' capacity for development.
2 **The more the merrier**	Quantity isn't everything. Managing too much feedback can lead to cognitive overload, be emotionally draining and harder for students to prioritise the key things to focus on for improvement.
3 **Feedback is telling**	Feedback as a monologue from teacher to student is not helpful. It is better centred around what the learner does, not what the teacher does. Students can learn to be the drivers of feedback.
4 **Feedback ends in telling**	Descriptive-only comments on a students' work is just "dangling data". For students to improve, they need clear support in closing the gap between their performance and their goals.

Figure 2. Feedback myths / nostrums. Feedback myths or nostrums, and the reasons they are problematic versus the reality. Adapted and summarized from Boud and Molloy.
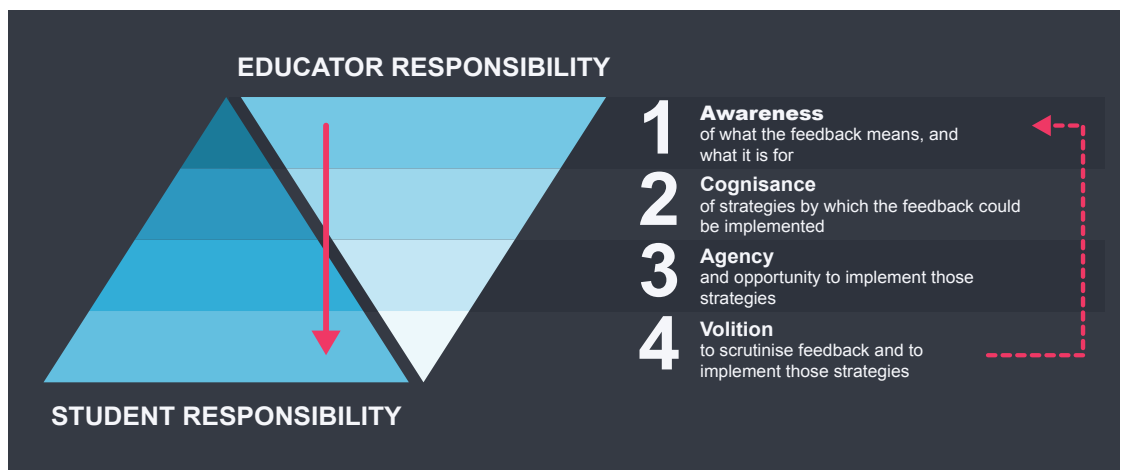

Figure 3. Improving active engagement with feedback through shared responsibility. A schematic showing a pathway to improve active engagement with feedback through shared responsibility. Initially, there is a greater educator responsibility to improve student awareness and cognisance. However, responsibility is shared with the students as they learn to develop their own agency and volition. This itself is a positive-feedback cycle. Adapted from Nash and Winstone.

feedback from marked assignments to improve their subsequent tasks.

Peer feedback

Students can learn more directly from each other too, in online guided peer feedback activities. Noroozi and Mulder randomly assigned students into threes on a biotechnology module. Students researched and wrote perspectives on a GMO-linked ethics topic, then made feedback comments on their two peers' assignments, supported by an online guide. Finally students received their peers' comments and incorporated them into their own essay.

All students completed this activity, encompassing the entire feedback cycle, simultaneously within a four-hour session. Even this brief timeframe was enough to increase domain-specific knowledge and induce attitudinal change towards GMOs, showing critical reflection on the material.

Broader course design

There is potential for embedding true feedback cycles within broader course design to increase the likelihood of productive opportunities.

Vanderleile and Alexander put this into practice in a second year metabolic biochemistry course. Teaching content was unchanged, but the assessment and feedback was renovated for better alignment, and used to support learning rather than just testing it.

This included a greater emphasis on online learning environments, more regular, low-stakes formative tasks and a broader variety of tasks including new creative assignments. The interventions coincided with significantly improved final grades, increased lecture attendance and better course engagement overall.

A new feedback culture

Developing good feedback practice at multiple levels, from individual comments to whole course redesign, can really pay dividends for students and staff.

These discussions are happening among a background of changes. From increased consumer identity among students, to enhanced technological capabilities, picking out true signals can be challenging.

But over time, it may be possible to generate a new culture of feedback in higher education. With students and staff sharing the responsibility more evenly, completing the feedback cycle could help students become better learners in their academic studies and throughout their lives. ■

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Further reading

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