

Audience Insights: Feed forward in Professional Development

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As a result of watching a colleague teach Tanya decided to make changes to her lecturing practice which resulted in very positive changes to students' evaluations of her lecturing. We describe the model of intra-departmental professional development in which she had the opportunity both to observe others teach and examine and discuss her own practice. The variation between a colleagues' lecture practice, her previous experience of lecturing practice, and her own practice perturbed her and provided the initial impetus for her decision. We call this a feed-forward mechanism.

1. Introduction.

At a previous DELTA conference Bill Barton asked us to consider how we support student learning as we lecture. He claimed that:

Lecturing is the interplay between the mathematical essence and the learning culture, and the teaching task is to make them work together to create better learning. The mathematical essence is not just a list of content, but includes the nature and uses of the subject, what it is like to act mathematically, and attitudes towards it. The learning culture refers to the expectations, intentions, and actions of both students and lecturers with respect to university pedagogy [1, p 965].

This paper focuses on two aspects of lecturing: the manner in which we display our attitude toward the mathematics we are teaching, and ways we consider our students. It describes the changes Tanya made to her practice after observing and discussing a colleague's teaching, and a visit to the circus.

We share the story of her teaching history and the change process and look beneath the surface for transferable mechanisms, to ask why she was perturbed and what is generalizable from her idiosyncratic path of change [2]. Her diary and reflections refer to key events in her decision to adopt a new approach toward lecturing. Her aim was to produce a more cheerful, interactive approach to lecturing, to bring more of herself into the teaching situation alongside the mathematics, and to pay more attention to the students' roles and expectations. This paper documents and explores her response to a professional development intervention and the manner in which it impacted her teaching and, according to her student evaluations, her students' engagement in the courses she teaches.

To establish a context for Tanya's reflection and enaction [2], we first describe the Development and Analysis of the Teaching of Undergraduate Mathematics (DATUM) professional development discussion group and its mode of operation. It was in this environment that she identified the type of change she wanted to make. We suggest that perception of variation provided the initial impetus for her perturbation. Finally we ask whether in situations such as this, what is being seen is an example not of the power of feedback but the impact of a feed forward mechanism.

2. The DATUM environment

This was the context that afforded Tanya the opportunity to reflect on her practice and to enact the changes in it [2]. It was here that she was able to observe, discuss and reflect on excerpts from her own and colleagues' teaching.

DATUM is a professional development project whose focus is the thoughtful, supportive, shared exploration of decisions made and actions taken during lectures. It builds on the theoretical frameworks of teaching-in-context and of the role played by Resources, Orientations and Goals in decision making, developed by Schoenfeld and his Teacher Model Group (TMG) at the University of California at Berkeley [3,4]. We also take note of Speer's admonishment to pay attention to "small, but meaningful, aspects of practice" [5, p.219], "at the very level of detail when development and change appear to occur—the moment-to-moment decisions and practices of teachers" [5, p.263].

Small groups of research mathematicians and mathematics educators, usually about 6 people, meet at regular intervals to re-examine their lecturing practice. Before each meeting one of the group chooses a lecture that they are happy to have video recorded. From this recording they select a section of less than five minutes for the whole group to watch and discuss. The discussion is audio-recorded and transcribed. Ahead of time the lecturer has reflected on their intended practice using Schoenfeld's Resources, Orientations and Goals (ROG) as a framework. This ROG is shared with the group.

While the choice of section is entirely up to the lecturer they frequently select a section that illustrates a decision point when they feel they have done something unexpected, or a teaching incident that raised a question for them. We generally found that while discussion initially focussed on the chosen segment we almost always went on to consider a range of issues of learning, practice and mathematics.

This model of professional development has been in development in the mathematics department at Auckland University since 2009 [1,6,7]. In 2013 the founding group divided into three new groups in order to be able to invite new participants. Tanya was one of these participants. Like others she had two recordings made of her lectures during the year. In the first semester she was recorded teaching students in a first course in calculus about continuity. We watched the colleague's lecture that provided the initial impetus for her reflection on practice and enactment of change soon after this. A couple of weeks later we then watched her lecture on continuity. In the second semester her lecture on partial derivatives and tangent planes was recorded and discussed.

3. Data

We draw on a variety of data sources in this paper: Tanya's recording of aspects of her teaching history and her diary of events described in this paper, her written Resources, Orientations and Goals (ROGs), video recordings of her lectures, the recorded conversations during DATUM meetings, and end of semester evaluations of the courses she taught in 2012 and 2013. It was after she received the latest evaluations that she shared with me, as the coordinator of the DATUM group she joined, the story we tell in this paper.

In the next section Tanya tells the story from her perspective: her history, diary and view of the entire process. Her history gives us some indication of how she may have developed the expertise and willingness to reflect that she brought to the process.

4. The story from Tanya's perspective

4.1. My teaching history

I began my teaching career as a secondary teacher in the former Soviet Union. I won a scholarship to Rice University to do a PhD in pure mathematics that I completed in 2003. Marriage brought me to New Zealand where I was employed on temporary part-time contracts as a teaching post-doc at Massey University. For the next 8 years I tried to pursue a research career at the same time as being a part-time working mum to three kids. Trying to prioritise my three roles in life: research, teaching and being a mother was very difficult. In

2012 I was happy to accept a job offer from the University of Auckland to become a Professional Teaching Fellow – permanent full-time employment for the first time in my life! Finally I could concentrate on one path and put my undivided energy into it.

4.2. From my diary

Table 1. Timeline of chain of events in 2012

Feb	I am pleased to be invited to join a DATUM group.
Mar 14	I wrote a ROG (Schoenfeld, 2011) for my lecture on Continuity (MATHS 108 is a Stage 1 Calculus/Linear algebra course taught to an audience of 300 students per stream).
Mar 15	Lecture on Continuity.
Mar 21	Discussion of colleague’s (Simon) lecture on Equivalence Relations to second year students.
Mar 24	Watched my lecture to choose a ‘slice’– I was beginning to think that my teaching style is a bit different from Simon’s.
April 4	Discussion of my lecture.
After April	At DATUM meetings I raised the topic of different teaching styles – my reflection process was brewing.
June	Lecturing Evaluations of MATHS 108 completed – feeling a bit upset about them – my active reflection begins and simmers during marking.
July	Mid-semester break visit to the circus and a breakthrough in reflection.
End of July	Semester Two begins. I am teaching MATHS 208, Stage II Calculus/Linear Algebra course – new teaching style from day one.
Oct 15	Lecture on Partial Derivatives and Tangent Planes for MATHS 108, Stage 1 Calculus/Linear Algebra course.
Oct 25	Discussion of my lecture.
Late Oct	My Lecturing Evaluations of MATHS 108 and 208 completed – a significant change.

4.3 My story of change

In 2012 as part of the professional development project DATUM I observed a number of different ways lecturers behave in class. In particular I was very impressed with Simon’s lecturing style mesmerizingly enthusiastic and cheerful. When I was watching the video of his lecture I was thinking that my lecturing style is quite similar to his - energetically charged and interactive. When I watched my own lecture it was a complete shock to me. I saw that I wasn’t as cheerful as I thought and certainly I was not coming across as an enthusiastic person who smiles easily. I only smiled a few times during the entire lecture. This was a revelation to me the image that I had in my head was not matching the reality.

All these thoughts were going through my mind but I had very little time on reflection it was week three of the semester, my first semester as a Professional Teaching Fellow at the University of Auckland. I was in survival mode just trying to get through the semester without making poor judgments. In the last week of the semester I received student feedback from my lecturing evaluation done on-line.

In response to the question ‘What improvement would you like to see?’ students said things like: “A bit more energetic when doing lectures” “Have more sense of humour and try not to talk in one tone all the time.” “More class involvement/activities.” “Not much. She is quite good, but her voice is slightly monotonous.” “Smile :-)” The last comment felt like a knife was stabbed through my heart that was the last drop to get me into a state of dissonance. I was seriously frustrated.

My first impulse was to just go to the next lecture and start smiling all the time easy, I thought. During the next lecture it became obvious to me that if I started smiling after every

sentence I would look like a lunatic it was simply impossible to do within my existing teaching style. I was coming to the conclusion that I needed to change my teaching style altogether in order to be able to smile more often, to show the students my energetic engaging self.

The semester ended. I had a few weeks of peace and a few weeks of marking and time to ponder. It was time to complete the reflection process and get ready for the next semester. In the holidays I took my kids to a circus. I found myself watching circus performers very closely while thinking about a comparison between a circus audience and a student audience. In both cases you pay money to come to a circus or to a lecture. At a circus you get pure entertainment and an audience is in a happy state clapping every minute or so. At my lecture students are hopefully learning but are not close to a state of being entertained so that they can clap every minute demonstrating their gratitude. Here it was the moment of breakthrough - at the circus. I knew exactly what I was going to do next semester and it was not me doing cartwheels during lectures it's better: I am going to take myself into the lecture, to introduce myself into the lectures alongside the mathematics.

During my first lecture for MATHS 208 to about 300 students I began with an introduction I spent ten minutes telling them the story of my life with some career advice here and there to keep it relevant. Most of them were smiling at me gratefully. After opening up to 300 people it felt very natural for me to introduce a Ukrainian chocolate prize for answering questions correctly. Ukrainian chocolate is a wrapped candy that I am able to throw quite far far enough to reach any student in a lecture room. I am not a natural thrower hence the entertainment! The students loved it. I never have to wait for an answer the students compete for speed as well as for correctness. It's like a game for them – an entertainment. Everyone is having fun at my lectures now, including me.

In the following sections we will examine aspects of the change process from a research perspective. First we will consider the importance of reflection and the role variation [8] played in provoking the perturbation or dissonance to which she refers. Second it is useful to consider aspects of lectures as performances. Finally we consider the role of a feed-forward mechanism in the change process.

5. The change process

5.1 Reflection

When Tanya returned to her room after the discussion of Simon's lecture to watch the video of her teaching she paid very careful attention to her demeanour. She was reflective paying "active, persistent and careful consideration" [9, p. 6], to how she presented herself. And what she noticed perturbed her. She subsequently received positive feedback during the discussion of her own lecture on continuity. No-one else commented on the aspect that concerned her.

We know how valuable feedback is. What do we know in the forward direction? She knew she needed to think about the future in the light of what she had observed. Towards the end of all subsequent DATUM discussions she would raise a question relating to style of delivery – asking people what they thought. It was clearly playing on her mind. Like Clarke and Hollingworth we view lecturer change as 'growth and learning' [2, p. 943] as they describe in their interconnected model of professional growth. While their model was developed and has been more widely used in school settings we find it useful in this tertiary situation. The particular value of this model is that it recognizes the idiosyncratic and individual nature of teacher professional growth" [2, p. 947] and enables the identification of

particular “change sequences” and “growth networks.” It incorporates the idea that “learning is an integral part of generative social practice in the lived-in world” [10, p. 35]. This allows what they refer to as the social “situatedness” of learning to enter the equation. It is clear that the discussions, the viewing of lectures and the student evaluations perturbed Tanya provoking dissonance, and that reflection on these and on her role as a lecturer or performer impacted on the outcome.

5.2 The role of variation.

Tanya perceived a variation between her previous experience of watching lectures and the one she saw Simon give. This was the initial impetus for her re-examination. In analysing Tanya’s response to watching Simon’s lecture we draw on ideas from variation theory.

Runesson [11] makes a compelling argument that variation is a necessary condition for learning. Her research is based in the classroom with children but we contend the arguments she presents work equally well in lecturer learning situations. She states that “From a variation theory perspective, to learn implies to experience, understand, perceive or see something in a different way,” [11, p. 397] that variation is the primary factor needed for discernment, which will lead to learning [8]. In order to discern or notice the aspect we have to experience a variation in that aspect. Further in variation theory learning is always about learning something, “learning has an object. In variation theory the object of learning is the capability to do something with something” [8, p.400]. Our question is thus not only why Tanya experienced a variation but also how she learned and what she did with what she had learned.

In the following discussion after Simon’s lecture we had been talking about how she encourages participation by getting students to nod when the following interchange occurred:

Tanya: But your point of difference that you differ from many other math lecturers, the ones I have seen in my life, who have taught me, he’s (sic) always in a good mood, he’s loving this, look at his face. Every pause you make you turn around and smile to the class. It’s amazing!

Simon: But I am really enjoying this because of the course and because of the students and that’s why I chose this one to be videoed because I am teaching another class I am not enjoying as much, even though I like the mathematics more, it’s because of the class.

We argue that this perturbed her to begin to consider lecturing as a performance.

A number of researchers who work in teacher development draw analogies between learning and journeys [12]. The impetus to undertake the journey is referred to by Cobb, Wood and Yaekel [13], who write of a trajectory of learning, an analogy that carries with it a sense of direction and initial thrust.

5.3 The role of perturbation and dissonance.

Tanya wrote “*that was the last drop to get me into a state of dissonance. I was seriously frustrated.*” Clarke writes that for a teacher who is for some reason perturbed a “healthy disequilibrium” has arisen leading them to re-examine their classroom practice [14]. A Best Evidence Synthesis of professional learning opportunities that impacted on student learning found that the effective professional learning situations usually began by creating dissonance of some type for the teachers [15]. The dissonance was designed to disturb in some way their existing views of teaching or learning.

5.4 The role of performance in lectures.

Later in the discussion of Simon’s lecture we considered the use of notation and symbols in mathematics and the need to translate them for students into ordinary language. At previous

meetings we had talked about the different ways in which lecturers verbalise symbolic statements.

Tanya: Maths is like a foreign language – you take long sentences that A concept and then you shorten it into very precise notation and if you don't know what the notation means it's like you don't speak the foreign language - you have no chance to understand it or what's behind it.

Immediately after this came the following interchange that focussed on the role of the 'theatrical or staged pause' and the performance that is a signal to think.

Simon: I wish I could speak more slowly

Judy: But you stop every so often ... you are good at pausing

Barry: There are a number of quiet moments ... There's also 'this' (gesticulates head scratching). I like the head scratching – as signal that you have stopped to think

Simon: It's hilarious – like a performance. Yes it's a conscious way to say you are supposed to stop and think

Barry: Yes that is the point

Simon: I sort of stare at the board – and I should say – I want you to stare at the board too but I can't bring myself to say that. So I stare at the board for them ... It's meant to be a signal for them

Judy: Contemplative. Is this staged contemplation?!

What perturbed Tanya was the mismatch between her lecturing experiences and what she saw Simon doing, the possibilities she perceived for herself and the mismatch between how she saw herself out of the classroom and the person she took into the lecture theatre “*I chose to shift my own behaviour in the direction of the one that best matched my personal way of interacting when not in lectures.*”

From the above discussion about performance in lectures it is apparent Tanya took many messages to help her achieve the change she envisaged – about speed of delivery, translating for students, pausing and signalling and the importance of performance. She does not mention these in her own reflection but it is clear from her student evaluations and from the second video that she did more than decide to be cheerful. The role of the students in the 'meaning making' in mathematics became prioritised in her lectures. It is interesting that she talks about the entertainment in terms of fun more than in terms of access. Her evaluations make it clear that she is both talking more slowly and pausing, providing more scaffolding for understanding the language and smiling.

As luck would have it Simon and the first author recorded and observed her lecture on Partial Derivatives and Tangent Planes. All the concepts were demonstrated on the surface of a large black umbrella with the aid of string, rulers and other props that Tanya took out of a capacious black bag – the resemblance to Mary Poppins was inescapable!! It was not just fun - the metaphors were considered and powerful and the communication of ideas paramount. The change was obvious.

5.5 The role of feed-forward in the change process

We ask whether, as we watch and consider others' teaching, a feed-forward mechanism may be activated? The role and importance of feedback in the learning cycle of both students and teachers is the subject of many studies and is summarised by Hattie in his much cited 2009 meta-analysis.

Feedback is most powerful when it is from the student to the teacher. When teachers seek, or at least are open to, feedback from students as to what students know, what they understand, where they make errors, when they have misconceptions, when they are not engaged—then teaching and learning can be synchronized and powerful. Feedback to teachers helps make learning visible [16, p. 173].

What might feed-forward be? We envision it as somewhat different from the Feedforward mechanism in computer networks or Marshall Goldsmith’s model [17]. The notion arose during an exchange with an interested outsider about the processes in the DATUM project. She asked whether the lecturers got feedback on their performances in lectures. We replied, “Not really – it’s more like feed-forward.” By this we mean exactly what happened to Tanya as she watched Simon’s lecture, his actions opened up future possibilities for her teaching. This idea is highlighted in the following interaction between two participants in the project during the discussion of how one had chosen to approach the teaching of continued fractions.

Simon: It would have been nice **to have said** ...

Greg reminds him that the future is ours to change, and of the aim of the project.

Greg: **You can always** – that’s what this project is about.

As with all professional development initiatives the big question is – what effect did the change have on student learning. In the next section we present data to evidence the positive impact the changes Tanya made had on her students.

6. Impact of the changes on students

At Auckland University student responses in evaluations are collected in two ways. The first is a Likert scale fixed format prompts section. Table 1 shows the mean response, where 5 is strongly agree and 1 is disagree, to three crucial prompts for the courses Tanya taught in 2012. The very substantial positive changes, with class sizes of 300 in Maths 108 and a total of 550 in two classes of MATHS 208, speak for themselves.

Item	MATHS 108 Semester 1	MATHS 108 Semester 2	MATHS 208 Semester 2
The lecturer responded to students’ questions in a constructive way	Mean 4.01 Std.Dev. 0.88	Mean 4.57 Std.Dev. 0.68	Mean 4.43 Std.Dev. 0.71
The lecturer stimulated my engagement in the learning process	Mean 3.69 Std.Dev. 1.00	Mean 4.49 Std.Dev. 0.77	Mean 4.25 Std.Dev. 0.80
Overall, the lecturer was an effective teacher	Mean 3.94 Std.Dev. 0.99	Mean 4.58 Std.Dev. 0.73	Mean 4.53 Std.Dev. 0.66

Table 2. Mean response from Evaluations.

The second section in the evaluations allows students to make open responses. The size of the classes means a wide range of responses are given. However themes are relatively easy to identify. In the first semester for MATHS 108, while many students were satisfied, the following are typical of the negative responses: “Tanya is very fast when she explains any concept or goes through examples. I suggest she slows down and gives us a moment to take it in and copy down any notes/examples.” “Focus more on ensuring that students understand than just rushing to get through all the slides.” “Increase student participation in class.” “I notice that you focus on just one part of the lecture, or just on the sheet in front of you. A little more eye contact with different sets of students in different parts of the hall should fix that”

The responses from the students in the both courses in the next semester are markedly different. “Tanya provided very good examples and worked through everything at a good speed in a way that everyone could understand.” “She is the BEST lecturer this semester. She is very cheerful, very interactive with students. Stimulates our learning. The atmosphere in her lectures is also very great!! I always look forward to going to her lectures.” “The fact that she takes her time ... explaining each step and assumptions she is making helps me to understand. She has good communication skills which always helps.” “I am not a big fan of

Ukrainian chocolates but I was really impressed with her ability to get the class to interact.” “Tanya’s use of props e.g. the umbrella was very helpful to visualise concepts.”

A particularly interesting subset of students was in her class in both semesters. Some of these were in MATHS 208 and others were the students that failed 108 in semester one and were repeating it. This was fortuitous in terms of their responses making valuable comparisons.

The following are open responses from some of these students: “I was very impressed with the change in teaching method/style from MATHS 108 to 208. Very impressed with the way Tanya expressed MATHS 208 stuff in lectures. Thank you.” “I had her as a lecturer for 108 and feel she has improved remarkably as she has slowed down and explained things in a much succinct and clear manner.” And finally: “The lecturer is much better to teach this year than last year. She always smiles and looks enjoyed to teach MATHS 208. Do you remember me? Haha! I suggested you to smile often in the lectures last year. I hope I pass this course and take stage 3 of maths courses with you teaching!”

7. Concluding remarks

As Clarke and Hollingsworth highlight productive professional development paths are idiosyncratic [2]. And while that is true there are also transferable lessons to be taken from Tanya’s professional development journey: watching excerpts from colleagues’ lectures and discussing decisions made can stimulate reflection, and re-viewing our own practice may be uncomfortable at times but can be the beginning of generating positive change. We will continue to explore the idea of a feed-forward mechanism in provoking change. We find it interesting that while writing this paper Tanya realised that she is now able to remember and draw on practices she remembers from ‘the best lecturer I ever had’ at Rice University, something she could not do in her old teaching style.

References

- [1] B. Barton, *Growing understanding of undergraduate mathematics: a good frame produces better tomatoes*. Int J Math Educ Sci Technol, 42(7) (2011), pp. 963-973.
- [2] D. Clarke, and H. Hollingsworth, *Elaborating a model of teacher professional growth*. Teaching and Teacher Educ, 18, (2002), pp. 947-967.
- [3] A. H. Schoenfeld, A. H. (2008). *On modeling teachers’ in-the-moment decision-making*. A. H. Schoenfeld ed., *A study of teaching: Multiple lenses, multiple views* (Journal for Research in Mathematics Education Monograph No. 14). National Council of Teachers of Mathematics, Reston, VA, 2008, pp. 45 – 96.
- [4] A. H. Schoenfeld, *How we think. A theory of goal-oriented decision making and its educational applications*. Routledge, New York, 2011.
- [5] N.M. Speer, *Connecting beliefs and practices: A fine-grained analysis of a college mathematics teacher’s collections of beliefs and their relationship to his instructional practices*. Cognition and Instruction, 26(2) (2008), pp. 218–267.
- [6] J. Paterson, M. Thomas, and S. Taylor, S. (2011). *Decisions, decisions, decisions: What determines the path taken in lectures?* Int J Math Educ Sci Technol, 42(7) (2011), pp. 985-995.
- [7] M. O. J. Thomas, B. Kensington-Miller, H. Bartholomew, B. Barton, J. Paterson, and C. Yoon, *Mathematics undergraduate teaching: Perspectives and interactions*, Conf New Zealand Assoc Res Educ., 2011.
- [8] J. Bowden, and F. Marton, *The University of Learning: Beyond Quality and Competence*. Kogan Page, London, 1998.
- [9] J. Dewey, J. *How we think*, Heath & Co, Boston, 1910.
- [10] J. Lave, and E. Wenger, *Situated learning: legitimate peripheral participation*, Cambridge University Press, Cambridge, 1991.
- [11] U. Runesson, *What is it possible to learn? On variation as a necessary condition for learning*, Scand J Educ Res. 50(4) (2006), pp 397 – 410

- [12] J. Paterson, *An instrumental case study of a professional development intervention that uses unfamiliar mathematics to prompt secondary teachers' re-thinking about learning and teaching*. (Unpublished PhD thesis). University of Auckland, New Zealand, 2008.
- [13] P. Cobb, T. Wood, and E. Yaeckel, (1990). *Classrooms: a learning environment for teachers and researchers*, R. B. Davis, C. A. Maher and N. Noddings eds., Constructivist views on the teaching and learning of Mathematics, N.C.T.M., Reston, VA., 1990, pp. 125-146.
- [14] M.T. Clarke, *Practice-Based professional development for teachers of mathematics teaching children mathematics*. N.C.T.M., Reston. VA., 2002
- [15] H.S. Timperley, A. Wilson, H. Barrar, and I. Fung, *Teacher Professional learning and development: Best evidence synthesis iteration*. Ministry of Education, Wellington, New Zealand, 2007.
- [16] J. Hattie, *Visible Learning; a synthesis of over 800 meta-analyses relating to achievement*, Routledge, London, 2009.
- [17] M. Goldsmith, Want to try Feedback? Rather try Feedforward! Retrieved from <http://www.hodu.com/employee-motivation.3.shtml> n.d.