Connections across the curriculum: Observations from the DATUM professional development project

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2013-2014 Team

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DATUM

- the Development and Analysis of the Teaching of Undergraduate Mathematics professional development discussion group
- Original project: 2009-2011 funded by TLRI

Aim: Develop a practical and effective discipline-related professional development programme for undergraduate mathematics lecturers.

Approach: Build on Schoenfeld’s theoretical model: Resources, Orientations & Goals (ROG)

Schoenfeld’s ROGs

- **Resources**: knowledge of the subject material; knowledge of the levels of the students; knowledge of how the content fits in the overall course structure.

- **Orientation**: beliefs, attitudes and values about mathematics teaching and learning; use of technology, active learning, student-lecturer interaction, student responsibly for their learning, skills vs conceptual understanding, service course vs maths major course.

- **Goals**: e.g. to keep all the students engaged throughout the lecture, appreciate the interconnectedness of mathematics, develop conceptual understanding of particular content or technique
Study Design

- Original funded study: Team of 4 maths educators and 4 mathematicians. Now, two groups have developed out of this with many new colleagues participating.
- Lecturers consider their ROGs both before and after the recording. For the study this was an iterative process.
- Record lectures for participants.
- Observer makes notes during the lecture.
- At the meeting to view the recording, the lecturer describes his/her ROGs, group watches and examines selected excerpt(s) from each lecture (usually less than 5 mins), and discusses informally. (These sessions were recorded and transcribed in the original study).
Choice and use of Excerpt

• Lecturer views recording - has right to veto all or some of recording.
• Lecturer chooses a section to watch with group, sometimes with help from the observer and/or the ‘camera person’.
• Characteristics - looking for unplanned decisions (e.g. triggered by student questions, lecturer realisations about lack of understanding, confusion etc), pedagogy, important mathematical moments, issues that exemplify an area of concern, e.g conflicts, mistakes...
• These act as a stimulus for discussion – viewing of videos is very rich, as we will now discuss.
Personal professional development
Personal professional development
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Personal professional development
Personal professional development
Personal professional development
Personal professional development
Participation in DATUM
Participation in DATUM
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Participation in DATUM
Partial derivatives & Tangent Plane

$20 - x^2 - y^2$
Substantial positive changes: data from students’ evaluations

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DATUM session example

Steve Taylor, lecture from MATHS 162 Modelling and Computation (18 August);

Mathematical content of the slice and his ROGs:
• Excerpt chosen: Introduction of Difference Equations;
• ROG: He wanted to give a practical example that was not complex to understand and he wanted to make use of MATLAB, chose examples that he felt would be interesting, accessible & motivate students.
Discussion

There was an initial discussion about the place of difference equations in general, and how we reference/teach them:

- A level of discrepancy was noted by Ben Martin: ‘it’s taught in the low level course but not even mentioned in the core courses and not linked to the characteristic equations taught in MATHS 250” (second course for maths majors);
- Tanya: “same in MATHS 208” (second service course);
- Vivien made a mention that the use of MATLAB enabled this in MATHS 162;
- Ben: It’s an amazing thing about this sessions that we discover all these connections between courses which we never new about – it really helps…”
Specific content example: Fibonacci sequence

The cameraperson observations (Tanya) caused the discussions to shift to the different part of the Steve’s lecture – the Fibonacci sequence (not the excerpt).

• Steve derived a general formula for the \( n^{\text{th}} \) term of the Fibonacci sequence during the lecture because he thought it was a great example for demonstrating the use of difference equation;

• In two previous lectures, Steve had introduced Fibonacci, using Matlab to calculate numbers directly from the difference equation, and used the \textit{analytical technique} in a similar simpler example with integer roots;

Ben raised the question: What other courses might this be used in? e.g. he uses the Fibonacci sequence in MATHS 250 as example of sequence
Tanya’s observation: “An amazing thing that happened that day: I was videoing Steve in the morning and noticed some of the students who take MATHS 208 which I was to teach later that day. My topic for the day was sequences – I was going to use the Fibonacci sequence as an opening motivation for the lecture.

- I was able to refer to Steve’s lecture earlier in the day and ask students about the general $n^{th}$ term formula of the Fibonacci sequence.
- Students jaws dropped at explicit connection that was made between the two courses in the same day.
- We believe this moment helped demystified the compartmentalisation of knowledge for students.
Concluding remarks: DATUM project

• It’s not a trivial process – it involves a significant commitment from the participants e.g. extra preparation for the recorded lecture, camera person and observer, choice of excerpt, distribution to, and prior viewing by participants, and meetings;

• But each step has its own particular benefits e.g. different perspectives & insights from watching colleagues teach, reflection on our teaching;

• The development of trust is essential. It is preferable to induct members to the group 1, or at most 2, at a time;

• The ROG framework is highly recommended since it was effective in developing and focussing the project, and enhanced discussion, but may not be essential;

• Community members be encouraged to develop self-awareness of their teaching style and to use this as a catalyst for change.
Concluding remarks: Curriculum Connections

• DATUM project provides a forum for discussion that allows us to gain insights into the overall structure of our programme - helps us identify content links between courses, including undergraduate to graduate level; this is a special outcome of this approach, resulting from the involvement of specialists from different disciplines;

• Identifying links for particular content across courses helps “demystify” mathematics for our students instead of the neatly packaged, unconnected set of topics that we sometimes present;

• Potential to motivate students to take other courses, and/or see the connections between them for students taking courses simultaneously (and consecutively);

• Quality control: Can improve consistency in notation and terminology for the same content/techniques in different courses;

• Interdisciplinary approach fosters professional connections between different mathematical areas (pure, applied maths, maths ed).
Additional References:


