SUMMARY FROM OPEN DISCUSSION

Participants

12 students.

All male.

Only 2 studying JUST maths (1 of these was a civil engineer who returned to uni to study applied maths, the other studies pure maths).

2 mature students.

Students were invited from 300-level courses and one 200-level course. 3 students were 100-level studying advanced papers (2 at 200-level, 1 at 300-level).

Why do maths?

Pure subject – can prove things which are true forever, no ambiguity, no extra explanation needed.

Complements / completes science subjects – can't understand science without maths.

Language of science.

Wide applicability – framework for understanding a lot of things.

Common cross-culturally.

Had to ask if anyone takes maths because it's fun – but good response to this.

Pure math student: inspired at young age by Stephen Hawkings "A brief history of Time" BUT don't like doing experiments!

Gives you a clear head – not necessarily in an educational sense, even in an everyday sense it is nice to think you can think logically and apply reasoning skills.

Why is maths enjoyable?

Like to know that what you're writing is the right answer (no wiggle-room; satisfaction of knowing you know something if you've learned it); clear-cut, definite, can be 100% prepared for exam with effort.

Like golf – can be really frustrating, but when you have a really good shot, you feel extremely satisfied – keeps you going back for more.

Challenging but rewarding.

Can be addictive.

What do you like about maths?

Not rote-learning; actually understanding things. Each year you become more logical, smarter, better at approaching problems – building upon previous levels. Building skills, not just knowledge.

Provides a tool for improving the future (in many different ways).

Can be creative and innovative.

The 'aha' moment!

Can apply the skills you learn to unseen problems and make progress.

The genius step in proofs – "one moment of awesomeness".

Beauty.

What keeps you studying maths?

Useful and interesting, so much to learn.

Crazy maths applications – e.g. maths of juggling, rubiks cube, knitting, etc.

Rush of endorphins when you get that 'aha' moment.

Always somewhere to go.

Trying to figure out how the geniuses do it.

Communication in mathematics

(For me) all about communicating results / reasons, etc.

Agreement that communication is important, but hard to know to what extent – do you write the answer, or every step of working, or somewhere in-between? Can you skip steps if it is obvious?

Massively important… just because maths is underlying / fundamental to science doesn't mean it's fundamental to being a human being – we're not scientific in nature – communication adds that human aspect, allowing us to interact with the mathematics.

Do you have to be logical all the time? Do you have to be able to communicate your thoughts clearly all the time? Branches of mathematics were not necessarily clearly communicated in their inception. Unproved conjectures. In the face of this, is communication in the spur of the moment all it's cracked up to be, as important as discovering the results themselves?

Communicative efforts by students

"Do you actively put effort into being communicative in your assignments?" – chemistry/maths student: "definitely". Pure maths student: "no." – pure maths student tries to do as little work as possible for as high a mark as possible; laziness (communication is too much effort).

Students get mixed messages about the importance of communication or don't know how much communication is required. e.g. many lecturers write on assignments, "Explain your working with complete English sentences", but students are unclear as to how much needs to be explained and to what extent. Perhaps having an exemplar to refer to would be helpful? Also inconsistency across lecturers – one lecturer in semester 2 even said he doesn't know why people would bother writing words at all when they could just write maths, whereas others promote the use of words to link and explain the maths (including diagrams, etc.).

Communicative aspects by lecturers

Clear communication makes it easier to learn.

Easier to learn from a native speaker.

Easier to learn when lectures follow a textbook – multiple sources of language style presentation etc., clear structure.

Like real-life examples or analogies; analogies are really important to link the abstract (and sensible) mathematics to something familiar, to anchor it.

Ideally should be pitched at a level where it's easy to understand, rather than a high-thinking theoretical level… move from the understandable level to the theoretical level (symbolism, etc).

Hard to learn when writing on whiteboard is messy and lecturer speaks quickly – easy to get lost. Remedy: online notes? Or summaries posted AFTER lecture.

Writing should be slow, at a good enough pace for students to write themselves. When notes are handed out or put on display, lecturers tend to present material faster, making it harder to keep up unless you have already been through the material yourself to develop a base understanding. Also distracting to have notes in front of you – tendency to skip ahead or not listen, and when questions are asked and the answers are readily available in the notes, nobody answers. Also difficult if notes are available but not followed.

If lectures are videoed, students can fill in gaps that arose while they were sitting in the lecture.

Worked examples are valuable – pattern-matching – especially ones outside the course's textbook (complement or supplement the textbook rather than just presenting it).

Different ways of presenting things make it easier to follow – well-roundedness, e.g. minimal notes (handouts?) with full lectures.

Use of pictures really good (context: linear algebra) – appeal to intuition.

Active interaction – asking questions – can be good, but if it's too easy then it's embarrassing to answer and nobody wants to. Questions need to be designed to give lecturer feedback about student learning, not just to fill in the blank and "make students feel involved". If feedback is not sought by the lecturer, students need to be made comfortable enough to ask questions themselves when they want to know something – but this is hard because of disrupting the lectures, etc.

"Most of the times when I haven't understood something, it's because the lecturer is explaining it and doesn't understand that the class doesn't know, isn't up to scratch with them. There needs to be a system where the lecturer can gauge what the class has understood and what they haven't."

Online resources

Use of forums boosted with Learn (Moodle) – discussion with peers and lecturer. Really good the more people that get into it.

Learn (Moodle) is not transparent enough – "here it is, figure it out for yourself." For lecturers and students – perhaps training is in order? Or an easy transition period?

Online resources are good but need to be more realistic with expectations, e.g. how often students will check it / e-mails, etc.

High praise of MATH352 – essentially lectures taught as a distance programme. Videos for lectures posted at the beginning of the week, go through and do them at your own pace. Then in class time, have examples / clarification and work on problems. Videos: written on tablet like a whiteboard with voiceover, as though giving the lecture in front of the class on the whiteboard. No extra preparation time – recording was 'live', constructed on the fly, so anything that didn't make sense would be picked up on and corrected when it was written (live feedback mechanism). A 1-hour lecture could be watched over the space of 1.5-2 hours, repeating unclear sections as necessary, allowing students to formulate a list of questions for things they didn't understand and use the help session effectively.

Lecture videos: good to be able to watch them more than once, pause and rewind as necessary. Go back later when studying.

Advantage – material is available as resources able to be re-used for preparation etc.

Some students wouldn't like lecture videos as they would not be motivated to cover the material themselves – can't work at home.

Need for synchronous, instantaneous feedback – asking questions when they arise.

Online live lecture classroom (similar to Skype) – how is that different to a normal lecture?

If an online environment – shorter lectures (e.g. 10min), but more of them. Bite-sized so easy to focus and fit in. Also healthier – not staring at screen for hours on end.

Time lectures according to content goals, not time goals, with a maximum time. E.g. if it takes 40min to cover one 'module' of content, only have a 40min lecture. Mini-lectures in modules.

If moving to full online model, learning can't just be passive – students must have to do something to make them want to watch the lectures. E.g. report back (blog) on contents of the lecture.

Return of marks online not so great because you can't see what was on your paper – should see annotations or have some way of being able to link comments to actual things you did. (Especially relevant if you hand in a paper copy but get marks online.)

Department webpage versus Learn (Moodle) – doesn't really matter, most important things are consistency across courses, ease of use, having all things located in the same place. [Note: at UC, maths courses traditionally host online resources on their own pages based out of the department, rather than on the central system, which is now Moodle. Since Feb 22, there has been a huge shift towards Moodle, and now some maths courses are based on Moodle (like everything else) while some are still on the department page.]

Some feelings that Learn (Moodle) does not have the easiest layout to use (but this is down to customisation from the lecturers themselves), but the concept of Learn is really good. E.g. should be a link to forums from front page. If the lecturer knows what to do, it can work really well – so perhaps the university/department needs to gives more training/help to lecturers if the push to Learn is complete. Live update when new items are posted (e.g. by e-mail) is really helpful.

Possible idea – classroom chatbox (instant messaging). Could be very useful as "the majority of people doing this subject don't like to talk to each other" (face-to-face) – an instant messaging environment could help to bridge the gap and make it easier for people to work together and develop necessary (academic) communication skills.

Use of Facebook – more informal venue for online discussion. Made it easier to keep up with news, ask for help, etc.

Assessment

Written English feedback is very helpful, even on presentation aspects etc. Should be more than just ticks and crosses – some words about where things went wrong, what strategies could be employed, etc. Even though solutions are usually available, those are general whereas feedback should be unique to you (for instance, there are usually multiple ways to tackle a problem).

The amount of work done should be proportional to the marks gained; i.e. assignments should be weighted based on their size and the required effort (relative to the exam) rather than given small amounts of marks for a lot of work.

Setting assignments fortnightly seems about right – then you don't get behind, but don't get too stressed out.

A weekly assessment should be based around tutorial questions – nothing extra and strenuous. These should be the small marks, e.g. 5%.

Many students advocated more emphasis on assignments and less on exams, because assignments are a better test of learning and some people just can't sit exams well. Furthermore, in the real (academic) world, nobody sits down with 10 pages of problems to solve in 2hrs! However, some were unhappy, saying that they don't like working during term (laziness again!).

Having variable weighting between assignments and exams was attractive – e.g. you can choose to do optional assignments to lower the impact of the exam, or everyone can do the same but individually choose what to weight more, or everyone can do the same and weighting can be assigned from different options to optimise marks retrospectively.

Reward both ability and hard work!

Open-book exam is closer to the real world; however, questions should not become a lot harder as a result! But students who rely on notes in open-book tests probably won't have the time to answer all the questions anyway.

Many courses allow you to write your own formula sheet for exams. Students said they like doing this, but never use the sheets – instead, they use the creation of the sheets as study. A formula sheet is like a safety net.

Someone suggested that having things which take a lot of effort to find but which are not the focus of the exam, such as Fourier series representations of given functions, should be given in the exam to save time. Perhaps more information than is needed could be presented to prevent students from simply pretending to know what to do – e.g. have the Fourier series representations of several functions.

Comparison with schools

University is a better educational experience because everyone who is there wants to be there, wants to learn.

University is a more formal system because of larger classes, don't know anyone, don't converse with lecturer especially at lower undergrad levels. Becomes less formal as you progress.

Top students (especially maths students) found high school too easy – slip into a culture of laziness, not studying.

School presents an integrated model of learning: material is presented, examples are done (sometimes collaboratively) and then exercises are used to back up the learning – everything is broken into small pieces and reinforced with practice along the way in the classroom, allowing opportunity to raise questions as they arise, etc. At university, material is presented and it is up to the student to go away and learn it, practice etc. on their own. This requires more effort, but may be better for harder material which is not easily broken down into bite-sized chunks.

One student found the idea of integrating tutorial-style problems into lectures quite attractive: "interval training" – short periods of learning, then practice. Conversely, another student said he

found it hard to do problems in class, having just learnt the material – needs the time to sit down and sort it out in his own head.

The time pressure associated with doing exercises at the same time as learning was seen as unattractive. However, one student suggested that doing the first steps of problems was the most important, so the concern of not finishing need not be that concerning.

Miscellaneous

PD for lecturers – peer review of performance, by teacher (rather than researcher), etc.

Are lectures too long? One student admitted to turning off after about 40min (last 10min irrelevant) – another indicated that it usually takes 10min for things to get settled into the rhythm of the lecture (first 10min irrelevant).

Having a mid-lecture break in long lectures (10min in 2hrs) is good, but not necessary to have a 5min break in 50min lecture.

Splitting last 10min of a lecture which can't be fitted into one slot over into the next lecture (maybe up to 4 days later) is not as problematic as it may seem, especially if students revise in the meantime. Keeps material fresh in their head and links the lectures together (also provides motivation to come!). Moral: do not rush to squeeze things into a time limit.

Extension of splitting 10min – perhaps summarise previous lecture in first 5min.

Students seemed more comfortable with worked examples than exercises in lecture time – they need their own time and space to go away and get their head around the material (perhaps with reference to worked examples) before they can feel confident answering questions on it.

Idea to use clickers was positively received, especially for smaller classes (e.g. 300-level) – less room for abuse. Forces you to think about the question and make a simple decision, giving you instant feedback about whether or not you were right, which can tell you how well you know the material.

Drop-in sessions helpful because you can come and go as needed, work socially with peers, etc.

Nobody present used office hours; some admitted they didn't even know when the office hours were. Useful only for test preparation, and then only because nobody else comes at the same time so you are able to have the lecturer to yourself.

Students suggested that more introductory help with software packages would be useful. Students come from a variety of backgrounds and it cannot be assumed that all of them know exactly how to use every MATLAB function required for the course (for instance). These should be specific for each course, not just using a general-purpose introductory package.

One student suggested that people "find" mathematics at 3rd year (or later) – they don't set out to become mathematicians, instead taking it to supplement applications (e.g. physics, economics) before realising that they really love maths. We need to be wary of these different backgrounds.

Giving students MATLAB code (even in pseudocode) to use for assignments was seen as good by some, since then you aren't being tested on your coding skills, but bad by others, since it inhibits creativity – suggestion that you learn better when you struggle through something for yourself.

WRITTEN SUBMISSIONS FROM STUDENTS NOT AT DISCUSSION

(Students are all third-year. Students 1-3 are male, student 4 is female.)

Student 1

Things I find useful about teaching:

- Lecturer presenting notes at the same rate that student is writing them down, i.e. lecturer writing on board, etc. – not using power point.
- All material given in class so as to motivate the student to come to class, and thus absorb what is said as well as what is written. This may be bad for students that are unable to attend.
- Lots of headings, lots of pictures to explain concepts.

Student 2

I'd just like to put my two cents in regarding what I think is the best way to learn maths at uni:

Less emphasis on formal exams, more on assignments.

Some longer, project-like assignments in the second term, building on things learned in the first term, would be great. It's much easier for me to learn maths by finding things out for myself, than being lectured. What happened in MATH361 was that Alex gave us the choice of doing a 20% assignment and a 30% test, or a 50% test and no assignment (we couldn't see the assignment before deciding). "Optional" assignments like these do mean a bit more work for the lecturer, but it's really good to have the choice.

In most cases, computers should be used as a tool to help solve problems once we've already mastered doing them by hand (if it's possible to solve without a computer). Trying to learn MATLAB or Maple when you're also trying to understand the math theory is too confusing. Once you know the theory, computers are a great tool, especially to plot and visualise stuff you can't do by hand.

Online lectures are actually really good. For people like me who often absorb information more slowly than the pace of the lecture, it's good to be able to stop and start the video. Perhaps if lecturers used the document reader cameras + a microphone, things could be set up so that every lecture could be recorded without needing a cameraman. Yes it does encourage people to skip going to the actual lecture, but at 300-level I'd hope that virtually everyone would still turn up.

Discussion forums are great, and should probably be promoted / used more than they are now.

Student 3

I have a few points I would like to make:

1) I like it how Math 353 is run in regards of flexible hand in date. Obviously this wont work for large percentage work, but for items like tutorials (or items worth less than, say, 5%) being flexible with these hand in times is important because it is important that tutorials are done, as they will help you answer the assignments and exams that are worth more. If you have a day to do a 20% assignment and a 2% tutorial, you will throw away the tutorial to focus on the higher percentage. So flexible hand in dates are important in helping us learn.

2) I think having more numerical examples is important to understanding new material. This is so you can see how things work. I think this is even more important in pure maths courses as these are usually completely new and since in school and early university you have been focusing more on the Calculus part of mathematics. Back last semester when doing Math 321 (Rings and Fields) I would have found it more helpful if there were more numerical examples to go with all the new definitions that we were learning. So if more numerical examples are shown, not just definitions, this helps us to learn (well it would help me anyway).

Student 4

I really appreciate having a set text, even at 300 level.

I like getting solutions to problem sets, so I can tell if I'm doing things right.

I like the use of Learn's forums, compared to the department website where you can only download files etc.

I like the department's online marks checking ability, but again that's on Learn.

I prefer fortnightly assessment, as opposed to weekly or less often than fortnightly, but % should reflect amount of time expected to spend on it better (e.g. 353's 5% projects are more time-consuming than 363's 10% assignments).

I like labs, where appropriate.

I like take-home tests.

I like open-book exams.

I like team projects.

I like hands on work and applications.