DISCUSSION GROUP:
TRANSITION FROM GCSE TO AS AND A LEVEL

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The theme for this discussion group arose from research, conducted by Sue Cramp and Elena Nardi, into the introduction of the new AS and A Levels in Mathematics. The findings of this preliminary study have prompted Sue and Elena to submit an ESRC proposal to focus on transition in teaching and learning styles from GCSE to A Level. They hoped that the discussion group would explore general issues arising from the new AS and A Levels as well as providing guidance for possible questions and issues which could be incorporated into their new research.

The preliminary study was conducted during the first term of the new AS examination. Teachers were interviewed and an analysis of these interviews identified common themes as potential areas for discussion:

- The problems of larger classes with greater spread of ability.
- In-service training for existing teachers.
- The problem of resources.
- Proof.
- The new AS examination.
- The effects of the new post-16 curriculum on Further Mathematics.
- Changes in teaching and learning styles.
- The nature of the changes to the A and AS specifications.

The group engaged in lively discussion which covered many of these issues and raised new areas of interest. A summary of the discussion follows.

The problems of larger classes with greater spread of ability

- Class size has not generally increased even though students are encouraged to study 4 AS Levels in Year 12. Class size is similar to that in other popular subjects.
- Many classes contain students wanting to study Mathematics at university with others who just want to do AS Maths as their fourth A Level. The ability range in these classes is making it difficult to enable low ability students to learn whilst also challenging the top.
- Are all students ready for AS in one year? Some schools are putting on extra lessons for weaker students. Some schools provide bridging units, but these

need to be taught. Do we need summer schools for prospective A Level students?
- We want more students to study mathematics. It might be appropriate to think of A Level Mathematics as a 3-year course for some students and of AS as a 4 or 6 term course.

Modules and allocated teaching time

- Most schools have 9 to10 hours per fortnight per A Level subject. Some have had their time cut to accommodate the 4 AS subjects many students now take.
- Four AS's in one year are a real problem.
- Delivery time is very tight. The experience is of schools finishing teaching modules a week before the exam leaving very little time for revision work
- External modules in January mean that internal examinations can not be run at the same time. Perhaps the equivalent of a term of teaching time is lost due to examinations.
- Retaking modules can cause problems. There is no teaching time for revision. The idea of retaking modules can create a culture of "I'll do it later". In most schools pupils have to pay for their retake modules.
- It is difficult to decide when to enter students for the modules.
- Some schools enter candidates for modules in a 2+2+2 pattern starting in June of Y12. This works well for A Level students because there is extra consolidation time and maturity.
- Entering AS students for 4 modules means that they can choose their best 3. But AS may then take more than one year.
- Some independent schools are entering candidates for all 6 modules at the end of Y13 keeping to a linear route.
- Colleges have the flexibility to offer more modules because they have more students.
- There was concern that some Universities may not recognise an AS in Applied Mathematics.

Free Standing Mathematics Units

- FSMUs could be an answer for students wanting a mathematics course which also supports their study of other subjects, but some schools are not aware that they are available.
- These will be difficult to introduce at the moment with all the new initiatives demanding staff time. FSMU Assessment and expectations are different. This has its advantages for pupils but it is harder for staff in the current climate of change.
- FSMUs are unique in giving UCAS points for each unit.

Further Mathematics

- Further Mathematics uptake has not been affected in some schools but in others students have gone for breadth of subjects and are not taking Further Maths as their fourth AS. Parents are also concerned about breadth.

Assumed Knowledge and Standards

- Most topics in the assumed knowledge list used to be on the A Level syllabus.
- Students entered for GCSE intermediate level may not have met all the topics listed in the assumed knowledge.
- There is not enough time to teach the assumed knowledge and the specification material.
- The gap between A Level and GCSE is covered in some schools by teaching the assumed knowledge topics to all potential A Level students during their GCSE course. Then candidates are entered for intermediate or higher level GCSE as appropriate. This is possible in schools with sixth forms, as there is an awareness of the need, but more difficult in 11-16 schools with little or no experience of the new A Levels.
- Both staff and pupils perceive that AS and A Level Mathematics standards are higher than the standards for other subjects.

Early entry for GCSE

- The report 'Acceleration versus Enrichment' is welcomed. The mathematical community feels that enrichment, rather than acceleration, is most important.
- Some students who sit their GCSE examination at an early age have a 'right answer' attitude to mathematics and they find it hard to investigate and question
- Pupils sitting early GCSE in Y10 are often turned off mathematics in Y11 and then do not want to study for A Level. They often gain a grade lower than they might a year later.
- Some schools are entering students for Mathematics GCSE in January and then for Statistics GCSE in the summer of Y11. This is often giving good results.
- The number of early entries is being used as a measure of what schools are doing for their brightest pupils. A Level take up would give better success criteria than results, another success measure could be the confidence and willingness of students to undertake a mathematics course for their employer, but neither of these are easy to measure.

Teaching style

- Teaching and learning are not independent of the time available and the amount of syllabus to be covered.

- Does A Level teaching have to be more like a lecture? Teachers feel pressured to get through work rather than using problem solving and investigative methods.
- Engagement and discussion are important because they lead to formalisation.
- The ethos of 'learning from mistakes' is important to develop in the early stages.
- Should there be a difference in the way we teach Year 7 and A Level? Both need to be responsible for their own learning. But while Year 7 mathematics in generally lesson based the A Level students need to make good use of private study time and bring discussion topics to lessons.
- Do A level students absorb knowledge faster? Is this an empty vessel model? Teaching is about helping pupils develop the skills to understand their experiences.
- Is a change of style necessary? If pupils are used to one style of teaching in Y11 what happens if they have a different style for A Level? Do they need continuity of style or does the subject need a different approach at different levels? How much continuity should there be for students? As much as possible!
- Do we need to prepare our A Level students for University lectures? Lecturing is increasingly seen as an obsolete and dis-functional style of teaching. Many universities are trying to move towards the exploratory teaching style more commonly used in schools.

Student work patterns

- Teachers expect A Level students to spend at least as much time in private study as in lessons. The current life-style and culture of pupils having jobs go against this.
- Schools are experiencing very few of the 'overloaded' students who study for 5 hours a night, every night. Students will complete work if they know it is required for their next lesson. There is an example of a mathematics student who worked in a hotel the night before an A Level examination because he would loose his job if he did not turn up for his shift.
- Mathematics work outside of lessons is frequently low in student priorities. As teachers we want them to do little and often, but some subjects require essays and research and give longer deadlines. Students will often leave work until just before a deadline. This means that they are crisis-working for other subjects and coming to mathematics lessons without having reviewed previous work.
- These problems are mirrored in higher education.
- There is a difference between work patterns and expectations for GCSE and A Level. GCSE is fairly directed and rigid with a homework timetable allocating time for different subjects every night. A Level students are expected to organise their own private study time. Some schools are trying to ease the

change by offering an area to work in which is near the mathematics staff so that they can pop in and ask a question. Some students take advantage of this opportunity but those students most in need of this facility do not always turn up. However encouraging students to work in this way is showing what the work ethos should be.

Proof

- Without proof mathematics is mystical.
- Mathematics makes a unique contribution to thinking skills which are useful for all subjects.
- We need to convey the beauty and pleasure of mathematical arguments.
- Can pupils be given a fact and then asked to use it or do they need to prove it themselves? For example, some colleagues give the formulae for solving a quadratic equation but do not prove it, they say that students can use the formula just as well.
- "I used to prove things but I confess that I have slipped since it wasn't always necessary."
- Proof needs to be introduced early in the curriculum so that it follows through naturally.
- When should we use formal mathematical language? We have been reluctant to do so but perhaps we should re-introduce it.
- We are already proving but not using the associated words. We should not be frightened of saying that we are proving things.
- Proof can take a variety of forms and different types of proof are valid. A proof does not have to be algebraic or Euclidean. If we are clear about what we can assume then proof is just logical deduction.
- Textbooks have a far greater influence on teaching style than specifications. The way in which questions are phrased has an effect. Books which use the words deduce, derive and prove change the mathematical language used in lessons.
- Children find it difficult to say something is right when they know it is true. A classic example is proving that the square root of 2 is irrational. "We know that $\sqrt{2}$ is irrational, Miss", "Yes, but I want you to pretend it isn't…!"
- Students think of things as being true in some instances or in certain circumstances only. They will often prove things themselves by using counter examples. "I think I've found the rule. On no, it doesn't work there."

Non-specialist teachers, implications for PGCE courses and staff development.

- Non-specialist mathematics teachers sometimes use rote methods because that is the way they were taught. They do not always realise how the subject

develops. This means that it is possible for students to gain good results but not be prepared students for the next stage.

- Mathematicians see the connections between different areas of mathematics.
- PGCE students do not have as much experience of A Level teaching since the new specifications have been introduced. The experience they do have is often in the first block placement which is often too early in their development as teachers.
- PGCE students with mathematics related degrees may not have studied any analysis. Instead they may have concentrated on mathematical methods.
- In the 'old days' Statistics was not studied, now people have not met formal Euclidean Geometry.