IISME Response on the Senior Mathematics Curriculum

Our response is divided into the following sections:

- Comments on the consultation process
- Assumptions about target groups of students
- The role of technology
- Comments on interactions between courses
- Comments on specific course content

Comments on the consultation process

It is unfortunate that discussion has started on the senior curriculum before K-10 is confirmed; different assumptions about the final form of K-10 are making it is difficult to see which way things will go.

The curriculum documents need to contain statements about why a framework of four courses has been chosen and what assumptions have been made about the target groups and some justification for these assumptions. Without such clear statements different groups will make different and contradictory assumptions about this rationale and the consultation process will become fragmentary.

The same applies to the rationale statements within each course and the choice and ordering of topics. The philosophy and intent of the draft writers is not evident in the documents. In fact, we had to make several assumptions for our interpretive lens to make sense. Since people need to provide feedback in the context of their underlying assumptions we feel that this feedback should not become detached from the accompanying assumptions during the analysis of the consultative feedback.

Some statements are made about transitions between the courses. These need to be justified both with regard to what groups of students may take advantage of moving between courses and how the flow and integrity of the content is maintained for such students. Perhaps a visual framework of how the various courses fit together and develop from Years 9-10 is necessary. The design principles behind the current draft curriculum and an illustrative design brief need to be made available.

The content descriptions are vague and it is difficult to judge the depth of coverage. The ambiguous statements do not provide guidance to the depth to which the content will be taught. There is no indication of which lists are prescriptive and which list are merely illustrative. Clear indications need to be given about whether something is mandatory or is provided as just one example of a context or special case.

Permeating our entire discussion there was requirement of **professional discipline knowledge**. It is paramount that the teachers are presented with sufficient specific detail but also sufficient time to incorporate contexts. Furthermore, resources and professional development will need to be developed and implemented. Future of profession is in balance.

Assumptions about target groups of students

There was considerable concern expressed about the urgency to revolutionalise mathematics education to arrest current negative trends in student engagement with mathematics, mathematics literacy amongst students pursuing further study and an ongoing shortage of effectively trained mathematics teachers. Some students see mathematics courses as providing an entry pathway to get into university, others as a benefit once students are at university, while others as solid grounding for later careers. The range of mathematics courses should capture these aspects clearly.

There was consensus that any mathematics curriculum needs to cater to the needs of at least three different groups of students. These three main groups could be readily identified. Although further subdivision of the groups was certainly possible, there was no consensus on how.

- The first group are those who do not require or desire any further formal training in mathematics but need a level of functional numeracy beyond what was achieved by Year 10. It was agreed that Course A did cater well to this group, especially because of its more investigative, science-like structure. Some people also regarded Course B as catering to this group but for those with higher ability who might disengage with the content of A because it replicates parts of the junior curriculum. Others felt that an additional course (A+), similar to A, but targeted at more able students was desirable and that the course B was not suitable.

- The second group are those will require some level of mathematical competency for their future careers. Although Course C was regarded as the best example of a course that catered to such students, it was regarded as insufficient to just have this course. This second group is an extremely large group of students which can be subdivided in several incompatible ways. One could imagine a hierarchy of courses similar in intent to Course C but catering to less able (C-) and/or more able (C+) students, this could be achieved for varying the content, varying the depth of exploration of the content or varying the indicative time spent. There was a lot of disagreement about whether Course B had or was intended to have such a relationship to Course C. An alternative subdivision is possible with respect to interest areas or intended professions. Some saw Course B as being of comparable difficulty to Course C but intended for those professions who use more modern areas of mathematics (graph theory etc.) as opposed to those heavily reliant on traditional areas (calculus etc.) . There were however arguments that the high school years should be used to give a thorough grounding in generic areas rather than prepare students for specific careers,

- The third group of students are those with a passion or aptitude for mathematics who already know they want to do further studies in demanding fields. Such a course should be designed to be inspiring, to give a good indication of the opportunities available to the most adept students and to impart a good sense of what is unique about the discipline of mathematics. It was clear that Course D was intended for such students but there was disagreement about the structure, choice of topics, timing and relationship of this course to Course C.

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The role of technology

The promise of the framing paper with regards to embedding ICT in mathematics has not been captured. The appropriate use of technology within all of the mathematics curricula is essential and needs to be addressed at the national level rather than leaving its interpretation to the different states, different schools or different teachers. The level of ICT needs to be specified and supported by adequate professional development of teachers and the provision of resources.

The teaching and learning of some topics and aspects of mathematics lend themselves naturally to ICT. For example, large scale matrix manipulations are tedious and uninformative without computers but become trivial with computers. There is fear that if the manipulations are done as if by a 'black box' then students will not develop the required depth of understanding.

Technology could be used to extend the reach of stuidents and enable them to engage in more extended problem solving exercises. Mental structures and linking ideas and problem solving is missing.

Manipulative rigour. Necessary to get philosophy right. Blending not good

We advocate that all students should be competent in the use of spreadsheets.

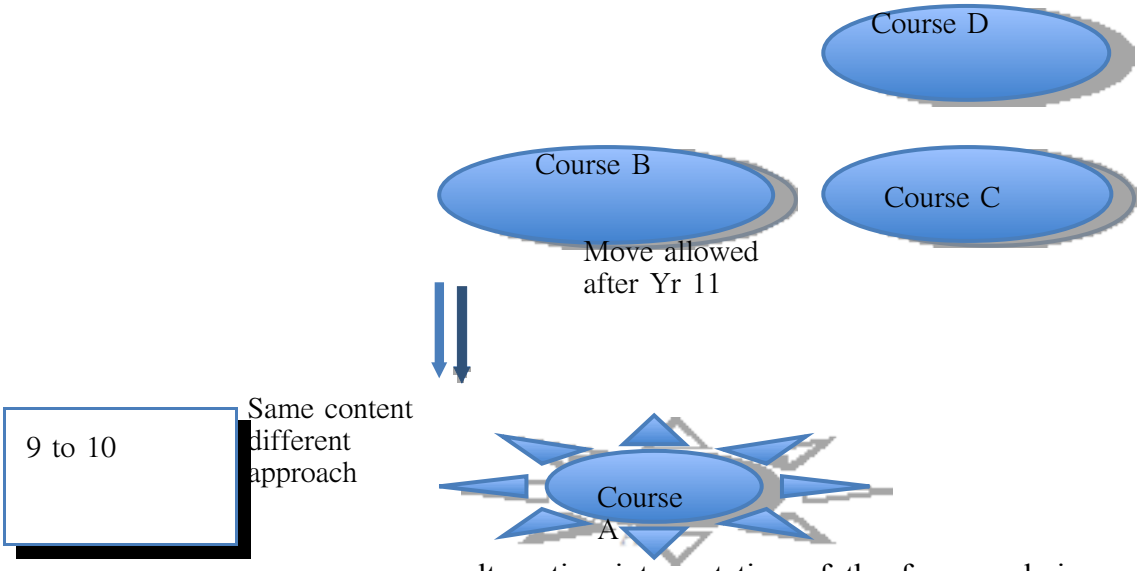
Comments on interactions between courses

We support the provision of four courses but have serious concerns about how they fit together. It is possible to view the courses as a single hierarchy catering the different levels of interest and ability; it is also possible to view the courses as modular and catering to different needs by offering combinations. These two philosophies are somewhat contradictory and the courses on offer don't achieve either goal satisfactorily. Another major concern is deferral of choice. Students have a much better idea of there interests, abilities and future intentions at the end of year 11 and frequently wish to change subjects. Provision of flexible pathways has serious resourcing implications (number of staff available, timetabling hours and rooms) and such issues should not be ignored during the early planning phases.

Our first interpretation of how the courses fit together is shown in the schematic below. Our schematic is based on the content in each, the level of difficulty of each course and actual content covered.

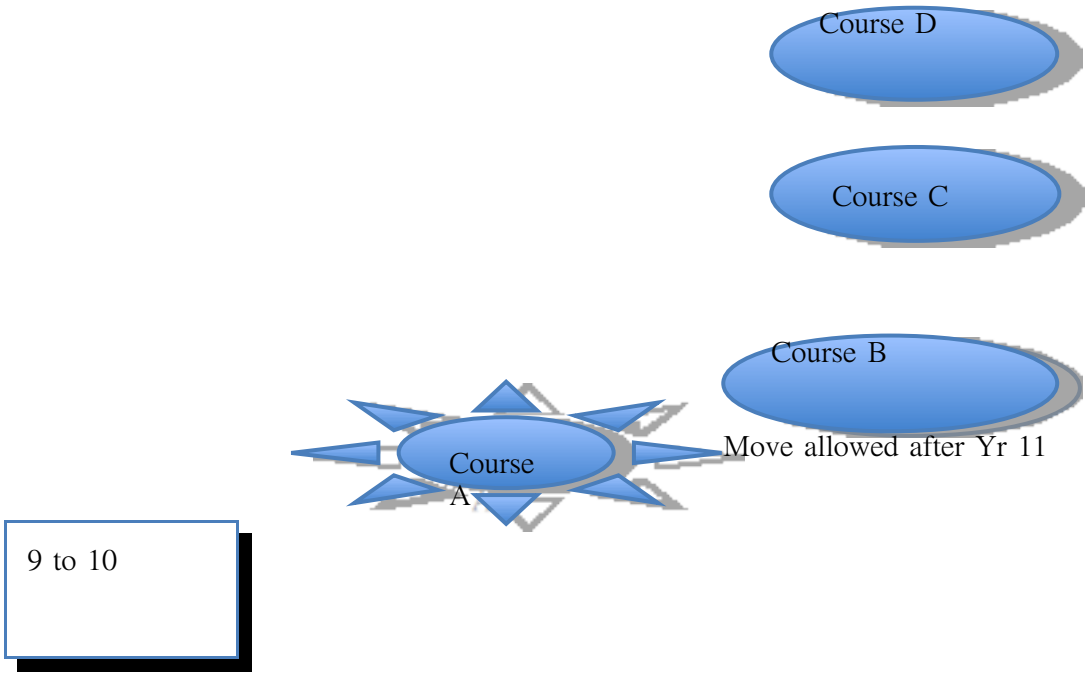
- Course A covers similar content to Years 9-10 but presents it in a more applied context utilising investigations and perhaps repackaged thematically. This course could be taught in the same way as Science subjects are taught with reference to the role of mathematics in society and mathematics as a human endeavour. Course A has different approach to all other courses.
- Courses B and C sit somewhat unsatisfactorily side by side, and students who find Course B difficult can make a transition to Course A after Year 11.
- Course D is independent but extends Course C.

This may not be the best scheme but some sort of deferral is vital so we can 'tempt' students to do 'just that much more mathematics for just that much longer'.



An alternative interpretation of the framework is as follows.

- There is some overlap between Years 9-10 and Course A.
- There is some overlap between Course A and Course B hence a move is allowed from Course B to Course A after year 11.
- Course C is more challenging and Course D extends further.
- There is no overlap between B, C, and D.



Comments on specific course content

We now provide feedback on each Course ASSUMING the first framework.

Course A does provide a basis for learning functional mathematics for the numerate citizen. Its main draw card is the investigative approach, and it is at the right level for students who have struggled with mathematics in earlier years but are willing to engage with mathematics at senior high school.

However, there are several challenges. Course A repeats substantial content that should have been learnt earlier but does not acknowledge this mathematics learnt in earlier years, apart from some broad statements. There may be an unfortunate tendency for good students to select Course A for a range of inappropriate reasons including maximising marks and then become bored and disengage with further learning. We recommend the following be given due consideration in shaping Course A.

- It is vital that some extension beyond 9-10 content is included otherwise the urgency of achieving standards in earlier years is undermined.
- How Course A is extending student learning should be made explicit.
- How Course A is different to 9-10 should be made explicit.
- The intended student body, aims and ambition of Course A should be made clearer.

Another issue is to do with students converting from Course B to Course A after Unit 2. Given that Course A has an investigative approach it is difficult to understand how students will blend in midway into Course A. This pathway needs to be carefully thought through because if these converting students cannot cope their attitudes towards mathematics may be damaged irrevocably. Unit 3 in Course A will need to support students who are new to the investigative approach as well as those who are used to the investigative approach.

Course B has major issues as it is very overcrowded. The sheer amount of content will scare students and teachers. Course B has a rationale with is build around modern mathematics, or possibly applied mathematics but it is called General Mathematics which is not particularly descriptive or intent. Course B also has some repetition of 7-10 content and this repetition needs to be justified and not simply briefly mentioned in the opening paragraphs. Some topics and idea that seem to be missing from this course are the concept of functions, symbolic manipulation and vectors. If these concepts are not developed early (when students are around 16 to 18 years of age) then they may not develop at all and so it is vital students see these before attempting further study.

Optional topics and/or investigations should be explored as a possibility for Course B.

Course C is the benchmark for further studies involving mathematics. There was concern expressed that it may become the default for a range of university courses and yet it is missing the following critical elements

- It does not embody the mathematical mind set
- The breadth of mathematical ideas is not sufficient.
- It does not frame what problems lead to the need for mathematics.
- It encourages symbol ‘pushing’ without understanding.
- It has no opportunities to investigate phenomena
- It contains calculus but does not have appropriate applications
- It has no vectors or geometry

Course D should provide inspirational mathematics for the adept learner. It again has too much content and appears to be dumping ground of content. The ordering is poor and the content distribution is not uniform. For example Unit 1 is very dense and Unit 2 is light in terms of content and difficulty. One option would be to have options in Course D and students/teachers could choose whatever motivates them. Choice can be dealt with creatively. This will help engage the enthusiast and/or the committed and avoid the boutique label. Overall though, if the content is appropriately culled, Course D would be a good course but it still needs the magic, it is dry, needs flavour .

The Courses should balance the maximum learning with right amount of challenges. When it comes to mathematics, students usually make strategic decisions by answering the following questions at the beginning of year 11 and again at the beginning of year 12.

- Will it help in getting the marks?
- Will it help once I get to uni?
- Can I do it?
- Talk to others, see textbooks
- How much do I need to devote to other subjects?
- Do I like it? Do I hate it?