AMESA POSITION ON PAPER 3

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Background:
The design and implementation of the NSC curriculum considered the legacy of inequality in the South African education system. The Ministerial Committee for Mathematics and Mathematics Literacy wrote in 2005 that:
In the light of these considerations the ministerial committee proposes that mathematics be offered by means of core and electives with every learner (ultimately) having equal access to all who take Mathematics, the optional electives would provide expanded opportunities for those with special interests and abilities. (DoE, 2005, p.39)

Thus currently, we have core Mathematics consisting of LO1, LO2, selected topics from LO3 and L04 and elective mathematics consisting of Recursive sequences, Euclidean geometry and Probability. These decisions took into careful consideration the following factors:

- The availability and capacity of mathematics teachers
- The readiness of most schools offering some form of mathematics to teach the core as proposed
- The extent to which the proposed core would articulate key mathematics concepts relevant to the expectations of the HE sector.

It was also planned that there would be a phased implementation of the electives so that effective teacher development and training could take place, such that the writing of Paper 3 would become compulsory at some later date. In particular, the DoE undertook to train the affected teachers so that they could be prepared to teach content and processes related to the optional assessment standards, with the view that in 2011 Paper 3 would become compulsory. Regrettably the envisaged training did not happen, and later the DoE announced that paper 3 would not be compulsory.

Hence, we found that many schools were not teaching the contents and skills associated with Paper 3. This could be attributed to the following reasons:

- The educator (s) at the given school did not have the required capacity to teach aspects related to Paper 3 content, like geometry and probability.
- Learners did not take up Mathematics Paper 3 because of its optional status and added load.
- Learners did not want to spend time on content they thought would have no benefit.

More importantly, we found that Applied Sciences and Engineering disciplines within Higher Education Institutions were signaling that the exclusion of specific content such as geometry for example, is affecting students' performance to a negative extent. This has been articulated in reports, which state that the pass marks for first year engineering students have dropped significantly compared to previous years. This kind of scenario indicates then that the current core content of mathematics is not necessarily sufficient for all disciplines of learning. It also suggests that the content of any kind of mathematical subject must take due cognizance of its purpose.

Taking 'due cognizance' of the above circumstances, the newly formed Department of Basic Education (DBE), have come forward with the following proposals.

- That the contents of paper 3 be brought back into core mathematics in the following manner:
  Euclidean Geometry to be in paper 2 and probability to be in paper 1. Paper 3 therefore will no longer be an optional paper.
- Technical High Schools should have a choice of offering either Engineering Mathematics or Mathematics in place of their current offer: Mathematical Literacy or Mathematics.
  Engineering Mathematics then would be designed to suite learners who would pursue trade industries and Mathematics would be for learners who would like to go to universities and technikons.
  Mathematical Literacy doesn't provide learners with the necessary skills they would need in trade.
- Training of teachers on the Euclidean Geometry and Probability should be done during school holidays for not less than two weeks in 2011, so that this can be implemented in 2012 in grade 10.

The DBE writing team will have to look at the feasibility of instilling the above proposals (changes). Hence, the DBE has equested the MPC to consider the proposals and respond to each of them with recommendations. Below is an outline of AMESA's position and recommendations on the DBE's Proposals.

1. (a) The Inclusion of Euclidean Geometry into Paper 2:
AMESA supports the DBE's recommendation that Euclidean Geometry should be included in Mathematics Paper 2. This is the only way in which a start can be made in making sure the total content of geometry is taught properly, also in the previous phases (R to 9). More importantly, geometry provides a more convenient "vehicle" to drive the development of both logical reasoning and deductive thinking, which helps us expand both mentally and mathematically. It is also important for students' success with further studies at tertiary level in the mathematical, engineering and health sciences for example. Apart from that, the average citizen of today will need proper understanding of the spatial demands of a highly technological driven society in order not to compete but merely to survive.

Euclidean Geometry is a necessary base for analytical geometry and also provides a framework by which to develop logical and deductive thinking skills, which all mathematics learners should experience and practice. The mere fact that the Geometry in paper three has been viewed as 'optional' has prompted a general approach from teachers to not teach any geometry in a proper way, at any level. More importantly it has allowed for a perpetuation of an elitist take on geometry as suitable only for the few and select amongst society.

Geometry is like a new content domain for the majority of teachers, not only from a teaching perspective but also from their own mathematical knowledge /earning perspective. Many if not most of the teachers have not been taught geometry a grade 7 level. Thus, the majority of teachers in our schools are NOT READY to teach the geometry content. Furthermore, the experience that education lecturers have at teaching geometry at both under-graduate and postgraduate level has shown that even experienced teachers (who are well trained) have a backlog in their geometry content knowledge as well as their pedagogical and curriculum specific knowledge of geometry.

AMESA therefore supports the DBE's plan on training teachers on Euclidean Geometry during school holidays in 2011, so that it can be taught in 2012 to grade 10. However, AMESA is also of the belief that coordinated and in-depth training, dealing with subject specific knowledge, subject didactical knowledge and curriculum specific knowledge is essential to address the historical backlogs in the knowledge base of most practicing teachers. Finally, educators need to be provided with well thought out and realistic pace-setters, which will enable them to complete and manage good teaching and learning and to ensure meaningful learning by our learners within the given time-frames without undue pressures.

(b) The Inclusion of Probability into Paper 1:
There are two opposing views with regard to the inclusion of probability into paper 1: Support and Non-Support.

The Non-support View:
Members indicated that the inclusion of Probability would increase the amount of content that needs to be taught in the given time. Members also indicated that it is not an essential prerequisite for further study, and that it can be taught as an independent unit at tertiary level at a later stage i.e. the element of continuity from school level to tertiary level with regard to probability is not necessary.

Support View:
Probability requires logical thinking, which is the same as Euclidean Geometry, and this is an opportunity we have to empower our learners in developing them into logical thinkers, particularly if they do not pursue higher studies after matriculating.

Many members believe that the Probability currently in paper 3 is not too demanding and the inclusion of it in paper 1 will not impact negatively on paper 1, but rather enhance the paper. However, substantial training must be provided for educators by experts in all aspects pertaining to the teaching, learning and assessment of aspects related to probability, in particular: time management, otherwise educators will claim that the curriculum is too large to teach in the given time.

Notwithstanding the above views, AMESA supports the DBE's proposal to include Probability in Paper 1.

Mathematics and Engineering Mathematics for Technical High Schools:
As indicated earlier, the content of Mathematics should be related to its purpose. It should also be borne in mind that while all learners need mathematics, not all need the same mathematics. Hence, AMESA is of the view that Technical High Schools should be given an opportunity to offer the kinds of mathematical subjects suited for its intended purpose.

Whilst, the rational for naming one such kind of mathematical subject as "Engineering Mathematics" is not fully explicit or understood, AMESA strongly recommends that a broader forum be consulted with regard to the naming of the subject and its actual content and skills focus.

However, AMESA in principle supports the proposal that Technical High Schools be given the opportunity to offer either Engineering Mathematics or Mathematics in place of their current offering of either Mathematical Literacy or Mathematics. Most certainly, Engineering Mathematics should be designed to develop the necessary skills, knowledge and values that will be beneficial for learners who would pursue trade industries. On the other hand Mathematics must also be offered at the technical schools, for learners who would like to go to universities and technikons. Obviously, mathematical literacy should not necessarily be offered at technical schools, if Mathematical Literacy doesn't give them enough skills to do trade industry. Once again, substantial training must be provided for educators by experts in all aspects pertaining to the teaching, learning and assessment of aspects related to engineering mathematics.

4. RECOMMENDATIONS

a) Euclidean Geometry should be included in Paper 2 and Probability should be included in Paper 1. There should be only two compulsory examination papers of 3 hours each. The marks of each paper should remain at one 150, so that majority of the learners will be able to cope with the paper time-wise.

b) Engineering kind of Mathematics should be offered at Technical High schools, so that the learners will be better prepared to enter the trade industry. Also Mathematics should be offered be offered at the technical schools, for learners who would like to go to universities and technikons.

c) Thorough continuous in-depth training should be provided to educators in geometry, probability and all aspects related to Engineering Mathematics. The training should be well organized and compulsory for all educators and no one should be left behind. The DBE should get experts to develop the training materials in Geometry and Probability, so that training and learning could be effectively accomplished at all levels with much understanding and confidence.

d) Undoubtedly, the core mathematics curriculum will become overloaded, with the inclusion of both Probability and Euclidean Geometry as compulsory content. Hence, the writing team should take cognizance of the available teaching time, and prepare a detailed teaching work schedule for each affected grade. The work schedule and pace setters should clearly indicate amongst other aspects, at least the topics/content and assessment standards that will be dealt with during each week during a given academic year, grade-wise. The developed work schedules should be work-shopped with all affected educators. There must be continuous supervision, monitoring at regular intervals at all levels of curriculum implementation. Unless, this is done diligently, the educators will always cite "time constraint" as an excuse if they do not complete the curriculum in a given grade in time for the final examinations or if their learners perform poorly in any of the examinations, particularly the grade 12 NSC examinations.

e) The writing team should decrease the weighting of transformation geometry because it is currently over-weighted. This could be one possible way to create some space for the weighting of Euclidean Geometry in Paper 2.

f) Furthermore, although trig reciprocal ratios and tan compound angles are "nice-tohaves", given time constraints, they do not add substantially to the skills that are being acquired in the curriculum. Most certainly, those who pass on to tertiary study can pick them up very quickly. This is another way to create space for Euclidean Geometry in Paper 2.

g.(i) In Gr. 10: Data handling (LO 10.4.1)
Leave out bar and compound bar graphs; histograms; pie charts; line and broken line graphs. These topics were covered in Gr. 8 and 9.
(ii) Instead, add the five number summary; box and whisker diagrams and ogives to Gr. 10 work from Gr. 11. This is another way in which as space can be created for the Inclusion of Probability.