Mathematics Pathways

2012 Chief Assessor's Report

Government of South Australia

SACE Board of SA

MATHEMATICS PATHWAYS

2012 CHIEF ASSESSOR'S REPORT

OVERVIEW

Chief Assessor's Reports give an overview of how students performed in the school and external assessments in relation to the learning requirements, assessment design criteria, and performance standards set out in the relevant subject outline. They provide information and advice regarding the assessment types, the application of the performance standards in school and external assessments, the quality of student performance, and any relevant statistical information.

SCHOOL ASSESSMENT

Assessment Type 1: Skills and Applications Tasks

Most tasks addressed the knowledge and understanding criterion and the application to theoretical and applied contexts well. The criterion referring to selection and use of techniques to find efficient solutions to routine and complex questions could not be met at the highest level due to inappropriate questions at the Year 12 standard; due to a lack of complexity in the questions, or of efficiency in the calculation methods used. For example, it is expected that:

- graphics calculators or computers would be used to calculate compound interest and annuities in preference to the use of formulae
- standard deviation would not be calculated by the table and formula method
- Applied Geometry tests would contain calculations involving mostly compound shapes, including the sine rule and cosine rule, with questions set in applied, problem-solving contexts. Questions using basic right-angled trigonometry should be limited.

In the skills and applications tasks assessment type it is not essential to develop a mathematical model to the same depth as in an investigation, but applying graphs and formulae to solve problems, interpreting results in the context of the problem and commenting on reasonableness, limitations, and assumptions are still expected. For example, if a comparative box plot needs to be drawn, interpretation of what the measures of centre and spread reveal about the higher performing group or the consistency of the data, as well as discussion of how outliers affect the reasonableness, should be included in the question design.

Communication of mathematical ideas and reasoning was generally well done with students showing their mathematical steps clearly in the process of solving problems. Mathematical symbols and notation were usually appropriately used, but sometimes terminology, labelling and worded responses were somewhat limited.

Although the content in Mathematics Pathways is more flexible than in Mathematical Applications, teachers must ensure that if they are omitting material from Mathematical Applications topics, that they are not omitting the difficult concepts and leaving the routine ideas only. In instances where this was seen, the content being assessed in the tasks was only Stage 1 standard or lower. There must be enough Stage 2 content in the course to allow students to achieve at the highest level. Some tests in which students had achieved full marks could not be given a result in the 'A'

grade band due to the lack of complexity of the questions. Statistics and Mathematics and Small Business topics showed improvement from last year, but the moderation team occasionally found Investment and Loans tests that contained simple and compound interest questions only. Also seen at moderation were Applied Geometry tests which contained limited or no questions involving compound shapes, focussing on simple trigonometry only. The topic support sheets for each topic of the Stage 2 Mathematical Applications course that indicate which key ideas are considered routine in nature or complex in nature are currently available within the Stage 2 Mathematical Applications support materials on the website. These will be made available in the Stage 2 Mathematics Pathways support materials page during 2013.

Other topics undertaken in courses in 2012 included: Formulae, Optimisation, Matrices, and Probability.

Most classes appeared to have a range of students that was too diverse to specialize in one very specific context, such as the trades.

Assessment Type 2: Folio

In general, there was an improvement in the quality of folio tasks this year. Statistics and Working with Data, Investments and Loans, Applied Geometry and Mathematics and Small Business were the most popular topics. The first investigation of the year may need to provide support and clear directions. Subsequent investigations should be less directed than the first. However, there should be an open-ended context in each investigation, providing students with the opportunity to make decisions about the path that they wish to undertake to further investigate the mathematical relationship, concept or problem.

For students to achieve at the highest level, and to assist teachers to verify student work, tasks should be designed to allow students to use individualised figures. These individualised figures can be provided by the teacher, or collected by the student. There should be at least two tasks of this individualised nature. In some instances there was evidence of investigations that had been completed by the students under supervision in a limited time. In this instance the students can be provided with the same data, however a folio assessment undertaken in this manner should be in addition to the minimum number of folio assessments required for the course.

Written discussions showed improvement this year. Students should be explicitly taught how to write discussions and conclusions that refer to the figures in their investigations, rather than simply making general comments.

It is important that students undertaking statistics investigations are aware that they need to collect numerical data rather than categorical data in their surveys. When categorical data is collected there was not enough opportunity for students to carry out mathematical processes that were of a Stage 2 standard. Tasks in Applied Geometry involving scale drawings or models need students to carry out mathematical calculations of compound areas and/or volumes and costings to accompany the scale drawing or model. Where students only constructed a scale drawing or model, without supporting mathematical calculations, their work showed insufficient evidence for achievement at the A grade band.

It is important that students use a report format for their folio tasks, beginning with an introduction that outlines the purpose and context of the investigation. The main body of the investigation should include evidence of appropriate application of the mathematical model or strategy; collection and/or generation of data; the

mathematical calculations carried out; and analysis and interpretation of the results (including an understanding of the reasonableness of the results and discussion of any limitations of the model or strategy used). The conclusion should be in the context of the original problem and provide an evaluation of the results of the investigation. Appendices and a bibliography should be included where appropriate. More detailed information can be found in the subject outline, and teachers and students should refer to this, and to the description of the specific features at each grade in the performance standards.

EXTERNAL ASSESSMENT

Assessment Type 3: Investigation

External investigations covered all topics. The most popular choices were a combination of two topics. For example, an investigation combining Mathematics and Small Business with Investments and Loans was common. Applied Geometry, used in a theme or series of connected problems was often connected with Mathematics and Small Business or Optimisation. Investigations centred on Statistics and Data were more popular this year. Matrices and Share Investments were chosen less frequently than the other topics.

The option of having advice on the external investigation draft was used by more than half of the schools. In general these schools produced tasks with a connected theme and clear objectives that allowed students to demonstrate their ability at the highest level. Teachers and students are reminded to refer to the support materials section of the Mathematical Pathways minisite for guidance on the preparation of the investigation.

Mathematical Knowledge their Skills and Application

In general, students were able to clearly display their level of knowledge and discerning use of mathematical algorithms. A concern is the significant proportion of students with very limited knowledge, who may have been more successful in an alternate course.

Task design must require learners to show knowledge and understanding of skills that are of an equivalent standard to the mathematics in the Stage 2 Mathematical Applications course. Significant numbers of students were not able to complete routine calculation problems, even at a standard much lower than Stage 2 Mathematical Applications.

Mathematical Modelling and Problem-solving

Student success was most evident where they had been explicitly taught how to apply problem-solving methods and analyse with reference to calculations in their mathematical models. Students were more successful in tasks where the initial purpose had a clear set of outcomes which could be supported by the analysis of calculations required in the investigation. In investigations with clear outcomes the students were better able to analyse the mathematical investigations in the context of the problem.

It was apparent that many students with reasonable knowledge and skills had little awareness of the appropriate way to respond to analysis and reflection problems. Some tasks limited student opportunity with questions requiring explanations that drew only on general knowledge (recount of definitions) rather than mathematical information or calculations that had been carried out in the investigation.

In some investigations, task design was heavily scaffolded throughout with little opportunity for students to show their problem-solving skills or their ability to critically analyse a situation. When the series of questions left little or no scope for student choice, it limited opportunity for analysis, reflection, or the need to draw a conclusion from evidence.

Communication of Mathematical Information

Generally, students made a genuine attempt to communicate the results of their work, and draw a meaningful conclusion in relation to the problem posed and based on their calculations throughout the investigation. However, many students showed limited working and reflection on the significance of results.

Students need to be encouraged to communicate the mathematical processes they have used e.g. interpretation or extrapolation, as well as making their answers clear. Communication is required to clarify the significance of their result in the context of the question, and taking into account reliability of information, errors and outliers.

Students often provided basic definitions in place of explaining the significance of a feature. For example, when students were asked to explain the significance of an outlier they gave a definition rather than referring to calculations that showed how the mean and range were distorted.

Task design

Well-designed investigations began with a significant problem to be investigated, and guidance that moved from some scaffolding to more open-ended questions. The linked questions were logical in their progression with response space for students to use provided throughout the task. The task built mathematical information that was relevant to a final decision so that analysis required use of the calculations to decide on a logical outcome. Purposeful choice was provided in the task rather than preferential choice (e.g. with reference to evidence from part a, (business was growing at 20% p.a.), what decisions would you propose concerning employing staff)? Questions of this style provided far more opportunities than a question requiring students to analyse data on Sport A or Sport B.

External marking was supported by accurate, comprehensive, well set out solutions on the final task. Where support information was provided for students this must also be provided for the markers (e.g. tables of information, diagrams etc.).

In general there has been an improvement in the design of external investigations as cohesive tasks, with clear objectives to be mathematically investigated and analysed.

OPERATIONAL ADVICE

When teachers package materials for the nominated sample that is submitted to the SACE Board for final moderation, each sample must include all tasks from Assessment Type 1 and Assessment Type 2. To assist the moderation process all student materials should be presented with a task sheet. An appropriate performance standards sheet, indicating the assessment of the work, significantly assisted the moderation team in the moderation process, particularly for the folio tasks. For a particular task all students should be assessed against the same specific features unless special provisions are implemented.

Some teachers included a cover sheet with each set of student materials from the nominated sample for moderation, identifying all completed assessments and the

grade level achieved. This assisted the moderation team in identifying reasons for missing materials. The 'Variations – Moderation Materials' form was also used successfully to provide the moderation team with information about special provisions, breaches of rules, and student materials marked but not available for submission. A completed mark sheet or spreadsheet for the class also assisted the moderation process when included.

A teacher folder with a complete set of task sheets and the approved learning and assessment plan (with addendum when applicable), should be included in the materials submitted. Where assessment work completed deviated from the approved learning and assessment plan, particularly for the whole class, this needs to be clearly indicated on the *Addendum* at the end of the learning and assessment plan submitted in the teacher folder.

It is essential that student materials are clearly identified, and that all of the materials are packaged according to the guidelines provided in the *Mathematics Pathways Subject Operational Information*, with each individual student's materials packaged in separate clear plastic bags.

For the external assessment process, the provision of two sets of clear solutions supports the marking of the external investigations.

GENERAL COMMENTS

Moderators noted a general improvement in the quality of tasks this year, in skills and applications tasks, folio tasks and external assessments. Although there is flexibility to teach to specific vocational needs or other student interest areas, Mathematics Pathways courses must contain sufficient complex mathematics of at least a Stage 2 Mathematical Applications level. The most successful approaches have been in schools where course counselling has matched students to this level appropriately.

Clarifying forums and involvement in moderation are all excellent opportunities for teachers to become more familiar with the requirements of this course which is only in its second year in 2012.

Mathematics Pathways
Chief Assessor