



Mathematics in Secondary Schools in the Cayman Islands

**A review of findings from school inspection reports
1997-2004**

A report commissioned by the Cayman Islands Schools' Inspectorate

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Foreword

The Cayman Islands Schools' Inspectorate is responsible for monitoring and reporting on educational standards in government and private schools. The Cayman Islands school evaluation model includes external inspection and self-evaluation by schools and is designed to contribute towards school effectiveness and improvement.

Each school is inspected once every six years. The inspections identify the school's strengths and the areas requiring attention. Between inspections, there is a formal monitoring visit to check on the progress the school has made in tackling the priority areas. Inspectors are guided by the criteria in the Cayman Islands *Handbook for the Self-Assessment and Inspection of Schools*.

Inspections provide schools, parents and the community, the Education Department and the Ministry of Education with an external and impartial evaluation of the quality of a school's work and its impact on students' learning and the standards they achieve. Through the publication of the summary inspection report, inspection contributes to accountability, transparency and openness within the education system.

The Inspectorate completed the first cycle of inspections in 2003. Following extensive consultation and research, the inspection model and the Handbook were revised to make them more useful to support school effectiveness and improvement. Changes were also made to the inspection reports, to improve their clarity and helpfulness for readers. This revised model was piloted in 2004 with inspection of a primary and a secondary school.

The Inspectorate also commissions thematic reports, which draw on findings from the school inspections, in order to report to the Ministry and to inform schools about the quality of a particular aspect of education on the Islands.

The Inspectorate trusts that this report will inform school leaders, teachers, the Education Department and the Ministry about the quality of mathematics education in the Cayman Islands' high schools. The findings and recommendations will, we hope, contribute in a positive way towards improving the teaching and learning of mathematics in the Cayman Islands.

Helena McVeigh
Acting Chief Inspector of Schools

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INTRODUCTION

Background

The Schools' Inspectorate is an independent office within the Ministry of Education, Human Resources and Culture and was established in 1996. The Chief Inspector reports to the Minister for Education via the Permanent Secretary and communicates inspection findings to the Chief Education Officer. The mission of the Inspectorate is to monitor and report on educational standards in government and private schools, and to contribute to their improvement through: independent inspection; training that supports schools' self-assessment and inspection; and high quality policy advice.

Its objectives are as follows:

- to deliver high quality inspections and reports on government and private educational institutions, within a regular and agreed cycle, and in full compliance with an agreed code of practice and published criteria for evaluation
- to provide training courses for schools and Education Department staff, which are relevant and effectively delivered, support the successful implementation of the self-assessment and inspection processes, and complement training provided by the Education Department
- to provide high quality advice, based on inspection findings, to assist in the formulation, implementation and evaluation of government policy.

Since the first cycle of inspections began in 1997, five secondary schools have been inspected (the three government schools and two private schools), resulting in five full inspection reports and five post-inspection reports. One of the schools has also received a full report arising from the second cycle of inspections, which started in February 2004. A list of when the schools were inspected is included in appendix 1.

Outline of this report

The Cayman Islands Schools' Inspectorate commissioned a report on the strengths and areas for improvement in mathematics and numeracy across the curriculum, in the secondary schools.

The report includes:

- A summary of the key strengths and areas for development in students' learning, the standards they achieve, the quality of the teaching and any other significant factors that are having an impact on students' achievement and learning.
- Commentary on any significant areas of progress made between 1997 and 2004, as reported in post-inspection reports or in the re-inspection report of one of the schools.
- Commentary on how the findings in the Cayman Islands compare with those in other countries.

Numeracy and mathematics defined

For the purposes of this report, the following definitions of numeracy and mathematics are used:

Numeracy is the proficiency which involves confidence and competence with numbers and measures. It requires an understanding of the number system, a repertoire of computational skills and an inclination and ability to solve number problems in a variety of contexts. Numeracy also demands practical understanding of the ways in which information is gathered by counting and measuring, and is presented in graphs, charts and tables.

Mathematics is defined here as the science that deals with numbers, quantities, shapes, patterns, measurement and the concepts related to them, and their relationships. Mathematics incorporates reasoning to enable students to draw logical conclusions, justify their answers and solution processes. In the context of this report, mathematics includes arithmetic, algebra, data analysis, probability, geometry, trigonometry and calculus.

PART I: SUMMARY OF THE INSPECTION FINDINGS

Main findings

- Overall, there has been an improvement in provision for mathematics in the secondary schools, both private and government, during the period 1997 to 2004.
- All inspection reports acknowledge the commitment and positive responses of mathematics teachers in both sectors.
- Students generally reach standards in number work that are in line with expectations internationally. However, there are weaknesses in their use of mental methods of computation.
- Students who are gifted mathematically reach standards that are at least in line with those of similar ages in other countries. Their manipulative algebra skills are strong.
- Standards in some other aspects of mathematics are lower than would be expected internationally. In particular, there are weaknesses in problem-solving, investigative skills and in shape and space. Work on data-handling is not tackled in sufficient depth in the majority of schools.
- Teaching is satisfactory overall, but often better at Key Stage 4 than Key Stage 3. The management of the students' behaviour is a major strength of the teaching.
- Generally, mathematics is taught by well qualified teachers. However, there are shortcomings in some teachers' understanding of mathematical concepts. In general, also, teachers use a very narrow range of methods in lessons.
- Learning is mostly sound, supported by students' good attitudes and high standards of behaviour. Students' achievements are, though, limited by their over-dependence on teachers and by their poor presentation skills.
- Able students often achieve well but those in lower-ability groups have less effective provision and so tend to make slower progress than they should. Boys generally achieve less well than girls.
- The transition from primary to secondary school is hindered by the lack of agreed benchmarks for the standards students are expected to reach by the end of the key stages. This causes significant discontinuity in students' learning.
- There is a wide variation in the amount of time given to the teaching of mathematics in Cayman Islands' schools. In some cases students are receiving significantly less teaching than would be expected internationally.
- Schools are mostly well resourced with text books and sometimes with practical materials. However, little attention is given to the use of information and communication technology (ICT) to enhance mathematics teaching and learning and, in this respect, schools lag behind international trends.

- Few schools have developed approaches to help students develop, use and apply their numeracy skills in subjects other than mathematics.
- Assessment systems are improving overall, but the use of formative assessment to adjust work in order to correct students' errors and misconceptions remains underdeveloped.
- Generally, mathematics departments benefit from good leadership and satisfactory management. However, teachers do not always receive sufficient guidance through the schemes of work. The monitoring of lessons and of students' work is not sufficiently systematic in the majority of the schools.
- Opportunities for training, particularly those focusing on teaching and learning, have been valued by teachers. However, there are not always enough funds to accommodate all those wishing to take part in such professional development.

Recommendations

- Schools require clearer guidance on the minimum standards expected of the average student at the end of Key Stages 3 and 4. This will facilitate valid comparisons across schools and allow for clearer international comparisons.
- Students' weak presentation skills require improvement in all schools.
- There is an urgent need to review boys' progress in mathematics and to identify and remedy the causes of their underachievement.
- In order to close the gap between the best and weakest teaching, there is a need to establish a clear understanding of what constitutes good practice, so that all teachers, whatever their backgrounds, are aware of what is expected of them.
- Teachers need further training so that they have a better understanding of the ways in which students learn mathematics. Teachers, in most schools, also need access to comprehensive schemes of work that provide suggestions for classroom learning and assessment activities.
- Professional development for teachers needs to have a stronger focus on the language and communication of mathematics, so that teachers will be more confident in promoting the students' oral work and mental methods in lessons.
- Schools need guidance on how to improve the transition between the primary and secondary phases of education.
- There is a need for greater consensus across the schools on the time allocation for mathematics.
- Schools need clear guidance on how to promote numeracy across the curriculum, to ensure that students have opportunities to use and enhance their mathematical skills in other subject areas.
- The development of ICT resources for teachers to model and demonstrate mathematics, particularly relating to shape, space and graphical work, is a matter of some urgency.
- Heads of mathematics departments need a clearer understanding of their role, and they require training to improve their skills in, for example, monitoring and evaluating the work of teachers and students.

PART 2: COMMENTARY ON INSPECTION FINDINGS

Changes over the inspection cycle.

1. All schools have improved aspects of their provision for mathematics over the inspection cycle. However, the rate of improvement has varied from just satisfactory to good, and is related to how well the school responded to the earlier inspection findings.
2. Across all schools, standards achieved by able students have been maintained in line with, and sometimes above, age-related expectations internationally. In three of the five schools, there were clear indications of improvements in able students' problem-solving and data-handling skills. However, other than in computational skills, too little progress has been made in improving the standards achieved by students in lower ability bands. Mental methods of calculation remain below expectations for most students and data-handling skills have improved significantly in only one of the five schools. Generally, expectations of boys, and of students in the lowest ability groups, are not high enough.
3. Early inspection findings indicated that some schools were entering students for examinations that were not best suited to their needs, being either too easy or too challenging for them. Generally, schools have attempted to respond to this finding.
4. Most mathematics departments have taken practical and manageable steps to overcome weaknesses in teaching identified by the inspection, whilst maintaining their strengths. At least one departmental leader has used demonstration lessons to model good practice. There has generally been good progress in improving the pace of lessons. Modest progress has been made in broadening the range of teaching styles to include practical activities and to match work to the needs of different groups of students. There are promising signs of teachers responding well to the areas identified for improvement in relation to marking and in the formulation of learning objectives for lessons. However, learning objectives are still not shared consistently with students. Also, too little progress has been made by teachers in the use of ongoing formative assessment of students' performance to adjust their planning and to guide teaching and learning. This remains a common weakness across all of the schools inspected.
5. Students' good attitudes to learning remain a strength in each of the schools. Nevertheless, students' poor presentation skills continue to hinder their learning, as does uninspiring homework in a number of the schools.
6. A major initiative in mathematics, the planning of a Key Stage 3 National Curriculum for the Cayman Islands, has not yet had enough impact on teaching and learning. The National Curriculum guidance is useful but does not specify clearly what the expectations are for the average student by the end of the key stages.
7. Post-inspection reports indicate that limited progress has been made by schools in preparing effective schemes of work that give clear guidance to teachers, not only on what to teach, but also how to teach it. This area for improvement is closely allied to the need for a clearer description of the roles and responsibilities of heads of department.

8. Some progress has been made in the use of ICT to enhance learning in mathematics but this varies widely between the schools. The most recent secondary inspection indicated that the department had made good progress on this issue, but this finding was not evident in the majority of schools.
9. The extent to which numeracy skills are being developed and consolidated across the curriculum also varies widely between schools. However, it is not given enough prominence in mathematics or other subject inspection reports for reliable comment to be made on its progress over the inspection cycle.
10. In conclusion, progress in mathematics has been reasonable over the inspection cycle but improvements have been hindered by the lack of agreed expectations for schools in relation to:
 - students' standards
 - the quality of teaching
 - target setting
 - assessment procedures
 - the role of the subject leader.

The quality of teaching and learning

11. The quality of teaching is generally judged to be satisfactory across all of the schools in the sample. However, there are clear indications that teaching is better at Key Stage 4, where external examinations lend more urgency to teachers' practice and to students' learning, than at Key Stage 3. The gap between the best and the weakest teaching is too wide. It results in an uneven experience for students within and across schools' mathematics departments.
12. In the main, teachers employ a very directive teaching style, dominated by, often lengthy, exposition. Inspection findings cite a significant number of examples where such practice led to over-passive students who were unaccustomed to thinking for themselves. Nevertheless, in many classrooms, teachers were confidently using robust questioning for parts of the lessons in an attempt to engage the students orally in the work. In almost all classes seen, students behaved well and responded appropriately to teachers' questions.
13. Inspectors also found that teachers planned conscientiously for lessons, sometimes in difficult circumstances. In one school, at Key Stage 3, for example, teachers' planning was based on out-dated textbooks that gave little attention to recent research into how students learn mathematics. Many teachers tackled all of the topics in the draft National Curriculum, rather than selecting those that suited the ability of their students.
14. Teachers are recruited from several countries and with varying experiences. Whilst adding richness to the teaching of mathematics, it also adds challenges, since teachers often have different expectations about how to teach mathematics. Most teachers have good qualifications and adequate subject knowledge but they do not always have a deep enough understanding of mathematical concepts. Several reports note examples of teachers adopting a mechanical and skills-based approach to teaching mathematics at the expense

of encouraging investigational, problem-solving and thinking strategies. This was particularly evident with younger students.

15. A number of common shortcomings were often evident in lessons in all schools inspected. Many of these were still issues in the post inspection, including:
 - Expectations were often too low for boys and for those students who found mathematics challenging or who were placed in lower ability groups.
 - Teaching methods and tasks were not varied enough to meet the needs of all students.
 - Too little attention was paid to the grouping of students within classes, particularly in mixed-age classes.
 - Rarely did students benefit from teachers' modelling of tasks.
 - Homework too often consisted of the completion of classroom tasks rather than of activities designed to consolidate and extend students' learning.
16. Although students often acquire mathematical skills and knowledge at a satisfactory rate in lessons, their skills as learners are not well enough developed. In particular, students are too often unaware of how well they are doing and of what they need to do to improve. Only rarely are they able to reflect on their relative strengths and weaknesses in mathematics.
17. Inspection findings indicate that whole-school assessment systems are improving. However, there is little use of ongoing formative assessment by teachers to adjust work in order to correct students' errors and misconceptions. The quality of marking and feedback to students was very variable, but the best practice provided students with sensible advice on how to improve.
18. The use of ICT to support teaching and learning in mathematics remains underdeveloped. There are a few examples of good practice, such as in the most recent secondary mathematics inspection report. However, there are significant inconsistencies between mathematics departments. A number of teachers are still not confident in using ICT to model work for students and there is not always ready access to suitable resources. There is little or no mention of the use of graphical calculators in any of the findings.

Standards of Achievement

19. Although there are few clear comparisons between the levels attained by students in the various examination courses, inspection findings indicate that, overall, standards are too low.
20. Able students across all schools often perform well in comparison with international expectations. However, other than in number skills, the standards achieved by students in most schools are below what is expected for all age groups internationally. This is especially so for students in Year 12 and for those assigned to lower ability groups. Boys often achieve lower standards than they should. In contrast, in one government school, students' performance in tests and examinations at the end of Years 9 and 12 improved significantly during the inspection cycle.
21. All schools have sustained and developed the good computational skills identified in inspections. These are in line with age-related standards internationally for most groups of students in both the private and government sectors. Students achieve higher standards in written calculations than in using mental methods, mostly because there has been too little

focus on mental arithmetic skills. This is a direct reflection of the main teaching style adopted by the majority of teachers.

22. Able students in all of the schools have good manipulative algebra skills. However, even these students often approach tasks as purely mechanical exercises, failing to appreciate the links between operations in number and algebra. There are difficulties reported at all levels in problem-solving and investigational tasks where students' standards of achievement lag well behind those of similar students in the United Kingdom. Following its initial inspection, one school had worked assiduously to prepare a list of projects and investigational tasks. However, the post-inspection found that these were "bolt-on" activities rather than integral to the mathematics teaching.
23. There is little evidence of extended writing for investigations and there is no mention of good practice in supporting students' learning in mathematics and literacy skills through, for example, writing frames that help students to record work.
24. Weaknesses in work on shape and space occur in most schools. Too little attention is devoted to developing students' geometrical, graphical and construction skills. Students' careless presentation, leading to inaccurate drawing and measurement, partly accounts for some of the low achievement. However, few schools are using ICT packages, which are a major tool in enthusing students and teachers in working on shape and space; this is in sharp contrast to the fast developing practice in the United Kingdom and South East Asia, for example. There was one good example cited of a school where students' mathematical understanding was strengthened as a result of an ICT package on control and modelling (LOGO).
25. Good data-handling skills were noted in one of the schools where students studied GCSE statistics. They had worked successfully on data-handling projects and were able to use their skills in other curricular areas. Generally, however, standards in data-handling are low. This is partly because of the superficial coverage in the curriculum and the lack of real opportunities for students to use their knowledge in worthwhile projects.
26. Discontinuities in students' learning occur at the transition from primary to secondary school. Secondary teachers often have low expectations of Year 7 students and there is often inadequate transfer of information from the primary schools. There is little mention in the reports of any agreed mechanism to support students at the transition between the two phases.
27. There is a clear link between the standards students achieve and the quality of teaching and learning in the classroom. Standards are too often depressed by the students' reliance on half-remembered rules, rather than on a clear understanding of previous work. This is particularly so where schools depend too heavily on a text-book driven curriculum. For example, in one school, students in their final year were able to follow complex notation in calculus, but they had no appreciation of how this related to finding the area under a simple linear graph.

Numeracy across the curriculum

28. The majority of inspection reports make little mention of how students use or enhance their mathematics in other subject areas. At best, students use some skills, such as graph-

plotting, data-handling and measurement, to good effect in science. However, in other areas such as geography and business studies, none were evident.

Other significant factors

Curriculum

29. There were issues about the mathematics curriculum and organisation in some of the schools, which were having an adverse effect on students' learning. For example, in one school, different year groups were allocated different amounts of time for mathematics. Some classes had almost double the time of others. In another school, mathematics topics were not revisited frequently enough so that students failed to remember concepts that they had been taught.
30. Schemes of work often focus too much on the content of the work, rather than on how it should be taught and what students should achieve. Schemes are often aligned closely to a particular published text, which is helpful in ensuring coverage of mathematics skills, but does not provide teachers with guidance on methodology. In one school, there was ready access to a stimulating staff mathematics library that included many recent publications on how students learn mathematics. There was, unfortunately, little evidence of this material contributing to the development of their scheme of work.
31. Few mathematics departments plan opportunities for students to experience mathematics in everyday situations or set work with an historical and cultural perspective. The study of mathematics in too many schools fails to promote an appreciation of its intrinsic worth.
32. Although some departments brightened classrooms with interesting displays, they gave too little attention to important areas in mathematics, such as the study of patterns in nature or the work of great mathematicians. One interesting example was cited, that of a department where classroom work drew on Celtic and Islamic patterns.

Learning resources

33. As noted above, the use of ICT and of other practical and visual materials is very limited. The availability of software to support the teaching of mathematics has improved significantly in recent years, and boys, in particular, often respond well to this medium. However, most schools lack enough equipment to maximise the benefits provided by the modelling and demonstration of mathematics through ICT. Inspectors note a need, not only for equipment, but also for guidance, training and technical support for teachers in order to make the best use of these expensive resources. Teachers could also make greater use of graphical calculators as teaching and learning aids.

Professional development

34. In several schools, inspection findings note that there is little collaborative planning within and across departments. Departmental meetings that are used to discuss the teaching and learning of mathematics would be an effective and inexpensive way for teachers to share ideas and expertise. Collaborative planning at departmental level would help to support the induction of teachers new to the school or to the Cayman Islands. Long-standing staff would also benefit from sharing ideas and experiences.

Leadership and Management

35. In the first full inspection cycle, few reports commented on the quality of leadership and management in mathematics departments. Where the effectiveness of the head of department was reported, it mainly related to the day-to-day management of the department, which was generally described as good. With the advent of the second cycle of inspections, there has been a clearer focus on leadership. In the first inspection in the second cycle, leadership was noted as strong, although, monitoring and evaluating the work of the department were weaker.

PART 3: INTERNATIONAL PERSPECTIVES

36. Mathematics education in the Cayman Islands draws much from Europe, particularly England, and from America, as well as the rest of the Caribbean.
37. Many of the issues related to mathematics in England are also of relevance to the Cayman Islands' schools. In some respects, though, the Cayman Islands compare very favourably. For example, there have been concerns for some time in England about the shortage of well qualified mathematics teachers and a low take up of the subject by students at advanced level. In the Cayman Islands, in contrast, there has generally not been a problem over the recruitment of suitably qualified specialist mathematics staff.
38. Concerns about mathematics education are evident around the world. The Japanese see a crisis in mathematics in their schools and call for wider mathematical literacy for all, including students in post-compulsory education. Research in the United States, involving the testing of pre-school students of different nationalities, indicated that the vast majority had reasonable informal competence in mathematics. However, a follow-up study found significant differences in the extent to which the different cultural groups met their potential.
39. In common with other educationalists internationally, the Cayman Islands' Education Department is aiming to raise standards in mathematics in both government and private schools. Historically the Cayman Islands' schools have a record of strength in written computational skills, which, until recently, were often stronger than those found in England. However, with the positive impact of the Key Stage 3 National Strategy for mathematics, students in English schools have developed much improved number skills, and, in particular, mental and non-standard methods of calculation. In this latter respect, the Cayman Islands' schools no longer compare favourably.
40. In international comparisons, England and Scotland often appear to fare badly. However, such comparisons frequently fail to include topics such as statistics and data-handling, or give credit for good performance in problem-solving. Problem-solving and investigative skills are generally stronger in English schools than in their European and American counterparts. The problem-solving dimension of mathematics is notably weaker than other elements in the Cayman Islands' schools, although there are signs of gradual improvement. It is worth noting that even in some successful South-East Asian economies, where mathematical skills are generally strong, students' ability to use and apply mathematics is often weak.
41. There is not yet enough reliable data on students' achievements in mathematics in the Cayman Islands. In English schools, for example, clear comparisons can be made for each school against national expectations at both Key Stage 3 and at the end of compulsory schooling. Progress with the development of a Cayman Islands National Curriculum for mathematics has been slow. Standards of achievement in mathematics in England have risen significantly at Key Stage 3 over the past three years, but progress has been slower at Key Stage 4. This picture of progress is in contrast to the current situation in the Cayman Islands, where improvement is more evident at Key Stage 4. A common feature of both systems is the high performance of able students. However, students of average and below-average ability achieve higher examination results in England than in the Cayman Islands.

42. The overall quality of mathematics teaching in England is now judged as good in two out of three schools. The picture within the Cayman Islands is less secure, but inspection judgements indicate that teaching is at least satisfactory overall.
43. Investment in ICT for schools and mathematics departments is strong in the United Kingdom, which has embraced enthusiastically such resources as graphical and scientific calculators and laptops for teachers. There is a similar picture in some of the successful economies of South-east Asia such as Singapore. English schools not only benefit from government funding to train teachers in ICT but also from a high computer-to-student ratio, approximately one to every four students. Some schools also benefit from being designated as specialist mathematics and computing colleges, with further funding from both government and industry. The use of ICT to enhance teaching and learning in mathematics is still very variable across the Cayman Islands' schools, although ITALIC is beginning to have a positive impact. Most of the inspection reports referred to in this review were written before the introduction of ITALIC.
44. Countries in the Pacific Rim devote much more time to the mathematics curriculum than is common in Europe and America. Students in England, for example, spend approximately three hours per week in mathematics lessons, whilst in the Pacific Rim countries they may spend as much as fifteen hours per week, especially younger secondary students. This necessarily affects performance. One year group in a Cayman Islands' school was reported to spend only around two and a half hours per week on mathematics.
45. The attitudes and behaviour of students within mathematics classes in the Cayman Islands is generally better than that in many schools, including those in the United Kingdom. There is an abundance of good will and much untapped potential among the students generally. It remains a priority to ensure that students of all abilities reach or exceed international standards in mathematics.

Appendix

Schools inspected

	Private/ Government	First full inspection	Post- Inspection	Re- inspection
Cayman Brac High School	Government	November 1997	May 1999	March 2004
George Hicks High School	Government	February 2000	February '03	
John Gray High School	Government	February 1999	November '02	
St Ignatius High School	Private	March 1999	May 2002	
Triple C School	Private	October 1999	May 2002	