Case Study of a Curriculum Audit of an Activity Based Mathematics Programme

by

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ABSTRACT

The need to evaluate curriculum practice and programmes used in educational institutions is a critical concern and one that is essential from time to time in all institutions. This paper considers the historical and present day perspective of programme evaluation practices including financial attest, performance, operational and enquiry audits, curriculum auditing and curriculum mapping. It presents a study for which the objectives were to ascertain the adequacy of an established programme and to provide strategic information regarding resources, student learning and staff development needs, in a large primary school (P-Year 6). A case study of a curriculum audit was conducted using programme evaluation principles and processes to establish the "fit" between an existing programme in Mathematics and a newly mandated outcomes-based Curriculum Standards and Framework (CSF). The curriculum audit followed the financial attest audit process. Audit findings indicated a favourable "fit" overall and highlighted the need for an increased use of calculators and databases at all levels, as well as the earlier introduction of spatial concepts, the teaching of chance at all levels and a push for greater depth of knowledge and understanding in number together with the increased use of mathematical language across the curriculum. Further studies using other curriculum areas would be useful to establish a set of guiding principles for others to use in determining strategic teaching and learning needs.

INTRODUCTION

In times of change, educational institutions may be required to review current practice and take on new programmes and projects, to address changing needs in the community. Often change is imposed from above, via the educational bureaucracy and the political forces at play in the community. Sometimes curriculum change requires a change in direction, a change in emphasis or even a radical departure from accepted practice and pedagogy. How do schools and institutions know what to keep, what to put aside and, more importantly, what to implement? This paper looks at ways that schools and institutions may evaluate current practices and programmes against introduced guidelines or policy changes. It is intended here to discuss the auditing process, in both its historical and present day context, and to examine its relevance in the curriculum evaluation process in schools, through a case study of a curriculum audit of school's Mathematics programme.

REVIEW OF LITERATURE

There is a growing literature on the subject of curriculum auditing which is a relatively new tool in programme evaluation. Programme evaluators have brought together a large repertoire of tools from differing fields to assist them with effective evaluation practices. Auditing as a process has its origins in accounting and bookkeeping. Historically an audit may be defined as "a critical examination of books, documents and records so that the auditor may report his opinion as to whether the balance sheets give a true and fair view of the state of affairs at balance date and whether the profit and loss account give a true and fair view of the results for the period it covers." The auditor has a critical and analytical function in verifying records (Irish, 1973).

Accounting processes developed slowly from established procedures used in England with the first Society of Accountants being established in Edinburgh in 1854. In the United States of America, higher education in accounting began in 1881 with the establishment of a school at the University of Pennsylvania. It is claimed that developments in accounting, in both Great Britain and the United States, have been hastened by the introduction of government legislation such as Taxation Acts or a perceived public need to correct abuses.

Authoritative accounting standards were not implemented until the 1930s, after the disasters of the stock market crashes in the late 1920s. In the United States, government departments are subjected to auditing procedures by the U.S. General Accounting Office (GAO) of which auditing and programme evaluation are important elements (Chelimsky, 1985). Auditing of accounts is now common accounting practice with many practitioners worldwide.

The origins of programme evaluation are a more recent phenomena. In the United States by the 1950s, there were two streams of endeavour, which influenced the development of programme evaluation. The first was the effort to rationalize the management and resource allocations of defence missions, which spawned the Planning, Programming and Budget System (PPBS) by the Department of Defence. The second was a series of experimental design and statistical analysis techniques used in agricultural research that were adopted and developed by social scientists from many disciplines and used on social programmes such as education, public health, criminal and delinquency programmes.

By the 1950s, evaluators in the United States had seriously begun developing large-scale retrospective evaluations using the methods of applied social science research. Although programme evaluation uses many of the techniques of auditing, there are fewer practitioners of programme evaluation than there are of auditing (Chelimsky, 1985). Programme evaluation in the Australian context is a relatively new discipline developing over the past two decades. There is, however, a substantial reservoir of innovative practice as seen in the published proceedings of conferences by the Australasian Evaluation Society (Owen; 1993).

As an evaluation tool, auditing derived from the examination of financial statements to the inspection of how programmes operate and how well they achieve their objectives (Chelimsky, 1985). Owen, for example, points out that the influence of financial auditing is evident in the performance audit definitions used by the US General Accounting Office which emphasise a strong economic thrust where outcomes, both financial and non-financial, are assessed in terms of input costs (Owen, 1993). In the social science inquiry area, programme evaluators have adopted auditing as a tool for checking the quality of programmes and evaluations specifically against a set of criteria. As a tool, auditing can be applied to:

- Studies such as research, evaluations and policy studies;
- Inquiry methodologies such as quasi-experimental designs;
- Inquiry paradigms and naturalistic evaluations such as interpretative and post positivist reports and evaluations (Schwandt and Halpern, 1988).

Schwandt and Halpern (1993) propose auditing as a legitimate method for evaluators to use in the field of metaevaluation. With applications in medicine, accounting and social science inquiry, the authors define auditing as:

- Commonly an accounting process;
- A process which shows whether or not management has properly prepared its financial statements to fairly represent historical, financial conditions;
- A procedure for evaluating some process or outcome against a set of criteria;
- An evaluation tool for checking the quality of a programme or accounting procedure.

Four types of auditing and their applications in varying forms of evaluation (Schwandt and Halpern, 1993).

1. The financial attest audit that uses the strict financial focus and purpose of the commonly understood meaning of the word audit, that is, the retrospective checking of records and programmes against a set of criteria to verify correct adherence to the guidelines.
2. The performance or programme audit where the audit examines the extent to which public programmes are operated efficiently and effectively. This type of audit is typically applied to government and public programmes.
3. The operational or management audit, which is effectively a form of quality control, which calls management's attention to some aspect of internal operation.
4. The inquiry audit, which is used to conduct peer reviews or quality control of research and evaluation studies and is typically applied to educational evaluations.

These types of audits are conducted by a combination of internal and external auditors - see Table 1 (Appendix 1). The influence of auditing in the strict historical sense as applied to accounting processes is favoured by Schwandt and Halpern who argue that the financial attest model of auditing is best suited to the evaluation of metaevaluation procedures.

Contrasting viewpoint of auditors and evaluators

Chelimsky (1985) states that there are some noticeable distinctions between auditing and programme evaluation. Programme evaluation is broader in its application and uses a wider repertoire of tools. These distinctions in definition and purpose are summarised in Table 2 (Appendix 1).

In spite of the different emphasis of evaluators and auditors, Chelimsky sees benefits in auditors and programme evaluators using aspects of each other's repertoire especially the use of statistical techniques for estimating effects in the absence of the programme and programme design. Chelimsky concludes that "Auditing is essentially normative, an examination of the match or discrepancy between a criterion (or standard or yardstick) and a condition (or the matter being audited)." This view is similar to the "Financial Attest" model proposed by Schwandt and Halpern (1991) and can clearly be used to judge or verify whether a programme measures up to an existing norm.

Thus, the Financial Attest Audit and the Inquiry Audit (Schwandt and Halpern, 1991) and that proposed by Chelimsky (1985) appear to be best suited to the programme requirements of schools. Both the Financial Attest model and that proposed by Chelimsky's definition need some modification when used in a curriculum audit situation such as whether they are conducted by internal or external personnel.

Curriculum Auditing

Another view of the curriculum audit is that of English (1988) who sees the curriculum audit as a powerful process, which can help to build “a new form of organisational effectiveness and efficiency in public education". For him a curriculum audit is a type of management audit.

English (1988) proposes three basic types of audit.

1. The functional audit which is concerned with the activities of the school such as personnel, administration, curriculum, maintenance and operations, school plant etc.
2. The operational audit which is centred on such items as curriculum development and staff development
3. The programmatic audit which is concerned with the subject matter of disciplines such as mathematics, health English or social studies.

These audits can be conducted either by internal or external auditors. The Curriculum Management Audit developed by Dr Fenwick English in 1979 is based on concepts pertaining to effective instruction and curriculum design and delivery. Terms that are relevant to the audit are:

- Scope which deals with how much of the function, operation or programme is included.
- Compliance, which deals with the degree to which the function, operation or programme adheres to a set of guidelines, laws, policies or regulations.
- Optimisation, which refers to whether inputs have influenced outputs.

This model sits with Schwandt and Halpern’s and Chelimsky’s models of audit discussed earlier and is used to design curriculum audits. The International Curriculum Management Centre (Anon: Anchorage School District Report, 2002) conducts curriculum audits globally based on the English model with an independent examination of three data sources: documents, interviews and site visits. In fact, the three different audits - functional, operational and programmatic - would be useful from a school's management perspective to delineate more specifically how the curriculum was to be audited. The programmatic audit would be useful for an outcomes audit as required by systems against head office imposed criteria.

Curriculum mapping

English (1984) discusses curriculum in terms of the written curriculum, the taught curriculum and the tested curriculum and proposes curriculum mapping as an "auditing technique for looking at the taught curriculum as reported by the teacher." According to English, mapping is an excellent tool to define the actual taught curriculum and deals with three things:

a) The content that was taught;
b) The time spent teaching;
c) The sequence of what was taught.

This process adds another dimension to the concept of auditing and represents a further movement away from the strictly financial view of auditing as a verification tool. Although strictly speaking, it is a process of verification of what is taught. This could then be held against a set of guidelines that may be useful in the establishment stages of producing guidelines or frameworks as with the CSF documents or school based curriculum. Elements of curriculum mapping can be seen in the model used in the Curriculum Management Audit (Anon: Anchorage School District Report, 2002).

Audit risk

When conducting a curriculum audit, there is always some risk involved. If the audit results are positive then the school or institutional community can be well satisfied with the curriculum programmes and policies. A negative result, on the other hand, may be cause for anxiety in the broader community if the school or institution is perceived to be providing inferior or deficient learning outcomes. This writer's view is that the results of an audit should directly benefit the institution's educational programmes regardless of the result. As part of the on-going review process, an audit is an extremely powerful and informative process that should lead to improved curriculum provision through greater knowledge about the content of the curriculum. It should provide schools and institutions with an indication of the strengths and weaknesses of their curriculum and programmes especially when judged against system wide outcomes and objectives.

THE CASE STUDY

As defined by McCorcle (1984), a case study is a detailed description of some evaluation or planning process in its real life context, i.e. a story in context. Case methods require techniques and rigour that may depart from traditional research designs and reporting criteria (McCorcle, 1985). McCorcle (1984) reports four criteria for reporting case studies. Firstly, the issue should be a significant issue or dilemma (Kyle and Ross, 1983). Secondly the case should be rich in detail. Thirdly the case should be descriptive. Fourthly, a case study requires a different focus than traditional reports of research or practice. The case study is able to examine the phenomena in the situation of the event occurring.

In his guidelines for writing case studies, McCorcle lists the following hints obtained from case writers and editors.

1. Choose a significant problem or provocative dilemma as the focus for the case analysis.
2. Describe the situation in lucid detail,

3. Ensure that the case is descriptive in nature.
4. Focus on the context and processes in the case situation.
5. Tell a story.
6. As the case is involved in human interactions the feelings engendered should be included in the report

The case study, outlined here, describes the application of an audit process (see earlier discussion) to the Mathematics curriculum of a large suburban primary school and fits the guidelines for writing case studies as outlined by McCorcle (1985).

Background

This paper reports a case study which was conducted, in the mid 1990s, where in the State of Victoria, in Australia, the Ministry of Education (now Department of Education and Training - DE&T), introduced the Curriculum Standards and Frameworks (CSF) Prep - Year10 (P-10), across the school system. The CSF documents were mandated requirements on schools providing outcome levels for curriculum provision across eight key learning areas (KLAs) – English, Mathematics, Science, Technology, Studies of Society and the Environment (SOSE), the Arts, Languages Other than English (LOTE) and Physical Education and Health, from preparatory level to Year 10. In 2005, the Curriculum and Standards Framework (CSF) have been replaced by the new Essential Learning Standards as the basis for curriculum and assessment with Victorian schools validating the Essential Learning Standards during 2005 ready for implementation in 2006 (VCAA, 2005).

In the Victorian system, primary schooling is from Prep to Year 6 and secondary schooling is from Years 7 – 10 and Years 11-12. The CSF groups curriculum in levels which span two years of schooling except for Level 1 which covers the first year or Preparatory Year only. Therefore, CSF Level 1 defines the curriculum for the Preparatory Year, CSF Level 2 defines the curriculum for Years 1 and 2, CSF Level 3 defines the curriculum for Years 3 and 4, CSF Level 4 defines the curriculum for Years 5 and 6, CSF Level 5 defines the curriculum for Years 7 and 8 and CSF Level 6 defines the curriculum for Years 9 and 10 of schooling - see Table 3 (Appendix 1). Years 11 to 12 curriculum is dealt with separately, Victorian Curriculum and Assessment Authority (VCAA)..

Schools developed their own school-based programmes in the key learning areas based on the CSF expectations. The CSF support document, "Using the CSF - An Introduction" (1995) used the term "audit" on page 8 as a heading, "Curriculum Audit and Review", and in the process introduced a new concept into school processes across the state. The implication was that “audit” was synonymous with "curriculum review" and sample audits, strategies and proforma were provided with subsequent advice on how to use audit data.

Given that curriculum is the specific information or knowledge in a given area that a community i.e. the school or institution undertakes to teach to its students, the CSF documents provide a systemic policy framework for the formulation of the specific, or explicit curriculum (English, 1984; Board of Studies, 1995). In other words, the CSF, introduced into Victorian schools in the mid 1990s, provided schools with a framework for a written curriculum as a basis for the taught curriculum. The Learning Assessment Programme (LAP) subsequently introduced at Years 3, 5 and 9 provided the basis for the tested curriculum so that there was feedback provided through assessment (English, 1984) which combined to provide a powerful curriculum in Victorian schools.

At a large, newly established Victorian primary school committed to an innovative "hands-on" activity based Mathematics Programme, the school needed to know the "fit" between the school's programme and the newly published and mandated CSF in Mathematics which presented the curriculum expectations in an outcomes based approach. It was clear that an audit of the school's Mathematics Programme against the Mathematics CSF was necessary so that the school could make planning decisions about the future of the school's current Mathematics Programme. The principal agreed to the subsequent internal audit of the School's Mathematical Programme against the newly published CSF in Mathematics. That audit was undertaken as a case study using the guidelines proposed by McCorcle (1985).

Designing the audit programme

Because the school had a large staff, it was possible to spread the work of the audit across year levels with teachers auditing the CSF level that corresponded to the year level they taught. The CSF levels relevant to the primary school are CSF Level 1 (Preparatory Year), CSF Level 2 (Years 1 and 2), CSF Level 3 (Years 3 and 4) and CSF Level 4 (Years 5 and 6). For instance, there were seven (7) staff available at CSF Level 1, ten (10) staff at CSF Level 2, seven (7) staff at CSF Level 3 and six (6) staff at CSF Level 4. See Table 3 (Appendix 1).

The audit was conducted in stages according to the five mathematical strands (or sections) in the Mathematics CSF. The five strands in the Mathematics CSF are:

- Space
- Number
- Measurement
- Chance and Data
- Mathematical Tools and Procedures

Each of the five strands is further divided into sub-strands, as follows:

<u>Space Sub-strands</u>

- Interpreting, drawing and making; Location (*1); Shapes; Transformation (*2).[1]

<u>Number Sub-strands</u>

- Numbers, counting and numeration; Mental computation and estimation; Written computation; Applying numbers; Number patterns and relationships

<u>Measurement Sub-strands</u>

- Choosing units; Measuring; Estimating; Time; Using relationships.

<u>Chance and Data Sub-strands</u>

- Chance; Posing questions and collecting data; Summarising and presenting data; Interpreting data.

<u>Mathematical Tools and Procedures Sub-strands</u>

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[1]* 1. Location – this sub-strand deals with the interpretation and description of position in patterns, maps, mazes and models such as directional pathways.

* 2. Transformation – this sub-strand deals with the manipulation of 2 dimensional shapes and 3 dimensional objects.

- Mathematical tools; Communicating mathematics; Strategies for mathematical investigations; Mathematical reasoning; Contexts for mathematics.

General procedures

The Number and Measurement Strands were audited by year level teachers in teams, the Chance and Data Strand and Tools and Procedures Strand were audited by the Mathematics Convenor and the Space Strand was audited by the Mathematics Committee consisting of teachers from all levels of the school. Analysis of data from the audit was completed by the Convenor with significant input from the Mathematics Committee. Presentation of the audit findings to the whole staff at Staff Meetings was shared amongst the Mathematics Committee members and the Convenor.

Timeline for conducting the audit

It was assumed that the audit could begin in Term 1 and be completed in Term 2. At the time the case study was conducted, schools across the Victorian school system were granted a pupil-free curriculum day in Term 1. That day was used to begin the audit process in the Number and Measurement Strands of the School's Mathematics Programme. Unfinished parts of the audit would be completed at area level meetings and at some scheduled staff meetings, before the Term Two presentation date. This proved to be a very ambitious expectation and the initial deadline had to be adjusted to Term 3.

Teachers completed less than was expected on the first day as the Number Strand, which contained the greatest content, proved to be time consuming. The school's Professional Development, or Staff In-service, schedule was reorganised and allocated to Mathematics until the audit and final presentation was completed. Auditing the Measurement Strand, however, was much easier and quicker than auditing the Number Strand and it was completed during a single staff meeting. The Convenor and Mathematics Committee completed their strands on time.

Structure

The initial day began with an information session, conducted by the Mathematics Convenor, on the Introduction to the Mathematics CSF and the audit process. It was explained that the audit was necessary to measure the school's Mathematics Programme against the CSF outcomes to see where the strengths and weaknesses were in the present programme, to allow for planning decisions, to plan follow-up in-service and to establish future resourcing needs.

Teachers were given copies of the School's Mathematics Programme expectations and Mathematics CSF level outcomes appropriate to their year levels. Teachers were asked to check the specific CSF outcome statements against the specific School's Mathematics Programme expectations, to "cut and paste" onto the CSF outcomes sheet and to note any deficiencies and irregularities such as items, which did not match up or were not covered in either document.

Observations

Teachers, across the school, generally approached the audit positively with interest and enthusiasm. Positive staff members and committed co-coordinators pulled the few dissenters into line, in the middle and lower grades. Teachers who were already integrating the use of the current Course Advice, using the “hands on” activity based approach to the teaching of Mathematics outlined in the School’s Mathematics Programme and who understood its format, worked quickly and efficiently at the task. Their comments were encouraging and these teachers were able to clearly see the benefits of what they were doing. They were increasing their understanding of both documents as they worked. They encouraged one another and used their own initiative to organise the task. A small group of dissenting voices, in the upper school, especially a more traditional male teacher who also happened to be the Year Five/Six area co-coordinator was tardy and unco-operative initially. However, this group eventually complied and completed the audit.

Data analysis

Data was collated and analysed by both the Mathematics Committee and Convenor with the final compilation being done by the Mathematics Convenor. Data was recorded on master sheets against the Curriculum Focus statements in each sub-strand. A summary document for all strands and sub-strands was compiled. (See Appendix 2 - Summary of the Mathematics Audit - School’s Mathematics Programme). Where there was a match between the two documents a comment such as "consistent with the School’s Mathematics Programme" or "covered by the School’s Mathematics Programme" was recorded next to the Curriculum Focus statement e.g. Written Computation - Level 2. Where there was a discrepancy, inconsistencies were recorded next to the Curriculum Focus statement e.g. Mental Computation and Estimation Level I - "not covered by the School’s Mathematics Programme - Recall automatically and use of doubles to 10.

RESULTS

Audit outcomes

Overall the School’s Mathematics Programme was found to be consistent with the CSF outcomes in most areas except for the Chance Strand, parts of the Mathematical Tools and Procedures Strand and parts of the Number Strand where the CSF outcomes required more depth. Mathematics Checklists had been written for the School’s Mathematics Programme some time earlier. These checklists had addressed some of the requirements in the Mathematics CSF in Number such as extending the size of numbers in use at various levels. The findings for each strand are summarised here and represented in Tables 4 to 8 - for more detail see Appendix 1.

Space Strand

This strand forms the basis for the later study of geometry. Curriculum Standards and Framework - Mathematics requirements pushed the boundaries and depth of knowledge required by the School’s Mathematics Programme and brought the study of maps, shapes and the vocabulary of space in at Levels 2 and 3. The School’s mathematic programme was consistent with the CSF at Level 1.The audit showed that computer access was needed from Levels 2 to 4 and that the school’s program required greater emphasis on the practical application of drawing and making shape at Level 4. See Table 4 (Appendix 1) for the “fit” between the between the Mathematics CSF and the School’s Mathematical programme in the Space Strand

Number Strand

Content wise this was the largest strand. Each sub-strand here in the School's Mathematics Programme was quite consistent with the CSF. Adjustments were needed to the school's course content at specific levels, particularly in the Numbers, counting and numeration sub-strand and the Mental computation and estimation sub-strand. The greatest change occurred at Level 1 and Level 2, in particular, where concepts previously taught later in the primary school were introduced at earlier levels and many existing concepts and skills were extended. Estimation, as a skill, was emphasised strongly in the CSF across levels. The CSF required greater depth of understanding and / or practical application. Discrepancies in the size of numbers in the Curriculum Standards and Framework - Mathematics had been addressed earlier in the writing of the school's own Checklists for its activity-based mathematics program. Table 5 (Appendix 1) represents the "fit" between the Mathematics CSF and the School's Mathematical Programme in the Number Strand

Measurement Strand

This strand was well covered by the School's Mathematics Programme and was consistent with Curriculum Standards and Framework - Mathematics requirements**.** Minor adjustments were required in the teaching of angles, capacity and schedules (time) at Level 3 and in teaching area and mass and in using cubes as a measure of volume in Level 4. Table 6 (Appendix 1) represents the "fit" between the Mathematics CSF and the School's Mathematical programme in the Measurement Strand

Chance and Data Strand

The data part of this strand was well covered in the School's Mathematics Programme, but there was greater emphasis required in computer usage in the Curriculum Standards and Framework - Mathematics. The School's Mathematics Programme only marginally covered the Chance component. Chance was a newly introduced aspect of Mathematics teaching in schools, in the CSF – Mathematics document especially at primary level. Table 7 (Appendix 1) represents the "fit" between the Mathematics CSF and the School's Mathematical Programme in the Chance and Data Strand.

Mathematical Tools and Procedures Strand

Some concepts in this strand were consistent with the School's Mathematics Programme but generally this strand pulled together many aspects of mathematics which did not fit into the outcomes approach of the Curriculum Standards and Framework - Mathematics and contained content that was not covered in the school's existing programme. Many were skills, concepts, ideas and knowledge, which needed to be taught and revisited frequently to maintain competence and to ensure they are not lost. While some were consistent with the School's Programme others were beyond the scope of the School's Mathematics Programme altogether. Overall the use of mathematical language was much deeper in the CSF. Table 8 (Appendix 1) represents the "fit" between the mathematics CSF and the School's Mathematical programme in the Mathematical Tools and Procedures Strand. See also Appendix 2: 8.1 Mathematical Tools and Procedures Strand for more details.

Staff reactions

On reflection, the audit was a lot of work for staff but they also acknowledged that their understanding of the content of the two documents was greatly enhanced. The audit generated much positive discussion about Mathematics and caused many staff to reflect on their own teaching of mathematics and the need to be more involved in activity-based mathematics. The audit alerted many staff to the actual breadth of content contained in both the School’s Mathematics Programme and the CSF and the extent to which the CSF requirements differed and pushed the existing boundaries of Mathematical expectations, in schools.

The audit also caused many staff to extend their repertoire of teaching activities. New teachers commented that the audit helped them to familiarise themselves with the School’s Mathematics Programme which was generally different to programmes they had used in other schools. The problem in the Grade 5/6 area resolved itself and caused those teachers to re-evaluate their current understandings and awareness of current educational practice and procedures. This was a positive outcome.

Procedural reflections

From an administrative perspective the audit was beneficial and achieved the purposes outlined earlier of determining the strengths and weaknesses of the current programme, providing planning information and identifying resource needs and follow up professional development needs for staff. Staff numbers, in a large school, allowed the workload to be spread into manageable units of work with teams of teachers targeting their specific levels only. Negative reactions from staff indicate that many staff had been insulated somewhat by the sheer size of the school from the realities of life in many smaller schools where the workload of the audit and developing understandings of the CSF through similar processes would have been a considerably more onerous task.

Where teachers were very familiar with the school's own Mathematics Programme and the Course Advice document, the audit process against the CSF document, when started, was not as threatening or as difficult as teachers first thought. It did prove threatening and time consuming where teachers were unfamiliar with both the school-based documents as well as the CSF document. Instead of auditing from a familiar to an unfamiliar document these teachers were working from the unfamiliar to the unfamiliar. In the upper school, the audit activity highlighted an area of weakness in the delivery of the Mathematics Programme, confronted the non-compliance of a group of teachers within the school and highlighted a specific individual and group area of professional development need.

The principal queried, in retrospect, whether this audit procedure was advisable. Upon reflection the positive benefits obtained from the audit outweighed the negatives. The Mathematics CSF outcomes were more specific and more numerous than those of other Key Learning Areas (KLAs) and warranted closer scrutiny than other KLAs. Schools need to know how effectively their current programmes address the Mathematics CSF outcomes for reasons already discussed. The change in emphasis such as the earlier introduction of aspects of Space and the push for greater understanding in such areas as Number, where more is asked of teachers and students, require greater understanding and knowledge from *both* subject convenors and classroom teachers.

Concluding Remarks

Change is best facilitated by knowledge and understanding so that teachers can assume responsibility for that change (Owen, Lambert and Stringer, 1994). An audit, which facilitates this, is more useful than implementation processes, which leave teachers and lecturers being "pushed" to include additional items into daily routines without an understanding of why the change is necessary. The audit process described here in Mathematics achieved this aim.

Additionally, the results of the audit described in this paper were used to make strategic adjustments to the school's Mathematics Programme and to enhance the curriculum delivery of mathematics across the school. These included:

1. Chance and Data Strand knowledge was supplemented by inviting a recognised expert in the field to the school to speak to staff and make recommendations. The cost of this was offset by inviting teachers from neighbouring schools to attend for a small fee.

2. A process to up-skill teachers in targeted areas of need was undertaken. For instance individual teachers were sent to attend specific in-service programmes related to areas of deficit in the school's Mathematics Programme and an in-house in-service programme was implemented.

3. Teachers visited other sites to observe "hands-on" mathematical teaching in action.

4. Resources were upgraded to provide teachers with both practical book references and sufficient teaching aids to implement mathematics effectively as indicated in the CSF. For instance, sets of calculators were purchased for all year levels and tubs of necessary equipment were provided at all levels.

5. Budget projections were made by the Mathematics Committee to implement a cyclic approach to resource development.

6. Teachers in the Prep to Year 2 area developed a shared approach to teaching aspects of the programme to make use of available resources for "hands-on" activities. For instance the Level 2 teachers developed a rotational process, at a set time, where units of work requiring specific equipment were taught and the development of units of work was shared.

The audit process applied to the Mathematics curriculum in the case study could be modelled against four of the forms of auditing discussed here - the Programmatic Audit of English, the Financial Attest and Inquiry models of Schwandt and Halpern and the view of auditing proposed by Chelimsky. All four forms could be used in the context of CSF auditing. The one used for the Mathematics audit in the case study most closely fits the definition of the Financial Attest Audit, using internal instead of external evaluators/auditors, as the existing curriculum programme was matched against a set of guidelines or principles, specifically the Mathematics outcomes as outlined in the Mathematics CSF document. The process, in fact, was a curriculum audit (English, 1988).

The curriculum audit process is a valuable tool to enable schools to understand the "fit" between an existing programme and new initiatives and directions. It also provides invaluable information relating to resources and staff development needs as well as placing the need for change into an understandable context.

REFERENCES

Anon (2002). Anchorage School District Audit Report, Phi Delta Kappa International. http://www.asdk12.org/depts/cei/audit/pdf/CurriculumAudit.pdf

Board of Studies (1995). *Curriculum and Standard's Framework: English,* Carlton, Victoria.

Board of Studies, (1995). *Using the CSF – an Introduction,* Carlton, Victoria.

Chelimsky, Eleanor (1985). C*omparing and contrasting auditing and evaluation - some notes on their relationship,* Evaluation Review, 9 (4), pp. 483-503

English, F. W. (1984). Curriculum Mapping and Management, in Sattes, Beth D., (ed.) *Promoting school excellence through the application of effective schools research*: Summary and Proceedings of a 1984 Regional Exchange Workshop, Nashville, Tennessee, April, 1984.

English, F. W. (1988). C*urriculum auditing,* Technomic Publishing Co., Lancaster, USA.

Irish, R. (Sir), (1972). *Auditing,* 4th ed., Law Book Co., Australia.

Kyle, D.W., and Ross, D.D. (1983). Evaluating qualitative research: criteria and their application. Paper presented at the meeting of the Evaluation Network, Chicago, IL. In McCorcle, Mitchell, D. (1984), *Stories in context: characteristics of useful case studies for planning and evaluation, Evaluation and Programme Planning,* Vol. 7, pp 205-208.

McCorcle, M. D (1984), *Stories in context: characteristics of a useful case, studies for planning and evaluation,* Evaluation and Programme Planning, Vol.7, pp.205-208.

Marshall, C. (1984). The case study evaluation - a means for managing organisational and political tensions, *Evaluation and Planning,* Vol.7, pp. 253-266.

Owen, J. M. (1993). *Programme evaluation: forms and approaches* , St Leonards : Allen and Unwin

Owen, J. M., Lambert, F. C and Stringer, W. N (1994). *Acquiring knowledge of implementation and change,* Knowledge Creation, Diffusion, Utilisation, 15 (3), pp 273*284.*

Schwandt, T. A. and Halpem, E. S. (1988). *Linking auditing and metaevaluation: enhancing quality in applied research*, Sage Publications, Newbery Park.

Stillman, L. (2001). Programme Evaluation and Toolkits for Evaluating the Impacts and Outcomes of Community Networking http://www.westylus.net/papers/toolkit/

VCAA (Victorian Curriculum and Assessment Authority) (2005). Victorian Essential Learning Standards, http://www.vcaa.vic.edu.au/prep10/vels/index.html , downloaded 23/06/2005

Walker, E.W. (1985). The conduct of programme evaluation: reviews in the general accounting office. *Evaluation and Programme Planning*, Vol. 8, pp 27-280.

Appendix 1 : Tables

Table 1. Some Definitions and Applications of Auditing (Schwandt and Halpern,1988)

l. Financial Attest Audit	2. Performance/ Programme Audit	3. Operational or Management Audit	4. Inquiry Audit
Purpose: to determine compliance with a set standard (generally accepted accounting principles) for financial accounting and reporting. By whom: external Focus: Retrospective examination for the purpose of forming an opinion as to fairness in conforming with generally accepted principles procedures.	Purpose: to explain the extent to which public programmes are operated efficiently and effectively. By whom: internal / external Focus: 3 types of information (Brown, Gallagher and Williams, 1982) Resources used to provide a service The quality of the service or goods produces Programme results	Purpose: to call managements attention to some aspect of internal operations (quality control). By whom: internal Focus: To review efficiency, effectiveness, Economy and performance. To review the use of organisational resources, information systems, internal controls, policies and procedures. To conduct formative evaluations that are departmental specific	Purpose: to conduct peer reviews or quality control of research and evaluation studies. By whom: internal / external Focus: To audit a particular situation against a set of standards, criteria, guidelines etc. To conduct educational evaluations and naturalistic inquiries.

Table 2. Contrasting viewpoints of evaluators and auditors (Chelimsky, 1985)

Dimension	Auditing	Programme evaluation
Types of questions	Normative questions	Normative questions Descriptive questions Cause and effect questions
Assumptions posited	Assumes that there is a correct and agreed upon way to do things.	A variety of designs used with a focus on the relationship between observed changes and the programme.
Outcomes	An audit does not produce estimates of what might have happened if the programme had not been assessed.	An evaluation does estimate what might have happened if the programme had not been assessed.

Table 3. Number classes and a comparison of year levels with the School's Mathematics Programme expectations and the CSF outcomes levels

Year level of Primary Schooling and number of classes in the study	School's Mathematics Programme expectations / levels	Curriculum Standards & Framework (CSF) levels
Prep Year(X7)	Level 1	Level 1
Year 1(X6)	Level 2	Level 2
Year 2(X4)	Level 3	Level 2
Year 3(X4)	Level 4	Level 3
Year 4(X3)	Level 5	Level 3
Year 5(X3)	Level 6	Level 4
Year 6(X3)	Level/s 7 and 8	Level 4

Table 4. Represents the "fit" between the Mathematics CSF and the School's Mathematical programme in the Space Strand

Mathematical Strand in CSF		School's Mathematical Programme		
		CSF expectations greater than school's programme	Content areas needing improvement	Consistent with CSF requirements
Space Strand	Level 1			Yes
	Level 2	Pushing existing boundaries.	Computer access required. Map usage. Location.	Yes except for: Location
	Level 3	Planes, solids.	Computer access required. Higher level vocabulary - shapes.	Yes except for: Location Transformation
	Level 4	More sophisticated use of spatial knowledge. Transformation. Practical application of interpretation, drawing and making shapes.	Computer access required.	Yes except for: Applying numbers Number patterns and relationships

Table 5. Represents the "fit" between the Mathematics CSF and the School's Mathematical Programme in the Number Strand

Mathematical Strand in CSF		School's Mathematical Programme		
		CSF expectations greater than school's programme, especially	Content areas needing improvement	Consistent with CSF requirements
Number Strand	Level 1	Extending requirements. Estimation. Doubles.	Zero as a number. Models of number to 10. Estimate collections to 20. Compare collections up to 10. Materials and models for part-whole understanding.	Yes except for: Numbers, counting and numeration Mental computation and estimation
	Level 2	Extending requirements. Automatic recall of facts & doubles to 20. Rounding to estimate (+/-) to 100. Greater emphasis doubling, patterns and some equations.	Count by 100 to 1000. Count backwards by 10s, 100s. Odd/ even numbers. Ordering to 999. Make, name, record to 999. Estimate large numbers with regrouping.	Yes except for: Numbers, counting and numeration Mental computation and estimation
	Level 3	Using more detailed strategies	Power of 10. Formal division 3 digits by 1 digit. Equivalent number statements. Use of brackets. Triangular numbers.	Yes
	Level 4	Extending course requirements and knowledge required Applying numbers	Compare / order decimals with uneven number of places. Problem solving strategies defined. Expressed rules for number sequences e.g. Fibonacci.	Yes except for: Problem-solving strategies

Table 6. Represents the "fit" between the mathematics CSF and the School's Mathematical programme in the Measurement Strand

Mathematical Strand in CSF		School's Mathematical Programme: CSF expectations greater than school's programme , especially	Content areas needing improvement	Consistent with CSF requirements
Measurement Strand	Level 1			Yes
	Level 2			Yes
	Level 3		Angles and capacity Schedules (time)	Yes
	Level 4		Volume, area, mass Cubes as a measure of volume	Yes

Table 7. Represents the "fit" between the Mathematics CSF and the School's Mathematical Programme in the Chance and Data Strand

Mathematical Strand in CSF		School's Mathematical Programme: CSF expectations greater than school's programme , especially	Content areas needing improvement	Consistent with CSF requirements
Chance and Data Strand	Level 1	Chance	Chance (probability) - not covered	No for chance Yes for Data
	Level 2	Chance	Chance (probability) - not covered	No for Chance Yes for Data
	Level 3	Chance	Chance (probability) - not covered	No for Chance Yes for Data
	Level 4	Chance	Databases needed / computer access needed Range of diagrams (Venn, tree, arrow) Chance (probability) - not covered	No for Chance Yes for Data with minor exceptions

Table 8. Represents the "fit" between the mathematics CSF and the School's Mathematical programme in the Mathematical Tools and Procedures Strand

Mathematical Strand in CSF		School's Mathematical Programme		
		CSF expectations greater than school's programme, especially:	Content areas needing improvement	Consistent with CSF requirements
Mathematical Tools and Procedures Strand	Level 1		Calculators Test by trial	No -Emphasis generally different, Communicating mathematics - number, space & measurement Mathematical reasoning
	Level 2	Spatial terms	Calculators Test, clarify, explore	No - Emphasis generally different. Location, direction, describing data collections Mathematical reasoning
	Level 3	Every day mathematical and measurement language Context for mathematics	Calculators Decimal use Strategy use Cultural & family influences (games) Context	No - Emphasis generally different. Measurement language Mathematical reasoning
	Level 4	Geometrical language Context for mathematics	Calculators (functions) Databases (computer access) Strategies / alternative uses Mathematical words in non-mathematical situations Cultural & family influences Context	No - Emphasis generally different. Number patterns, operations, symbol use, formal units and data interpretation Mathematical reasoning

Appendix 2: Summary of the Curriculum Audit Materials

Summary of Curriculum Audit: School's Mathematics Programme Audited Against the Mathematics Curriculum Standards and Framework (CSF) - Mathematics, Department of Education and Training (DE&T), Victoria, Australia. Note: The numbering of strands corresponds with the numbering used in the Mathematics CSF.

3.1: SPACE STRAND

Summary: This strand forms the basis for the later study of geometry. The CSF requirements push the boundaries and depth of knowledge required by the School's Mathematics Programme and generally brings the study of shapes, maps and the vocabulary of space in at an earlier level than the School's Mathematics Programme has done.

3.2: Interpreting, drawing and making
Level 1: Consistent with School's Mathematics Programme
Level 2: Consistent but pushes the depth of knowledge required by the School's Mathematics Programme at its Level 2, Level 3
Level 3: Requires greater knowledge of planes/solids than gained from School's Mathematics Programme at its Level 4, Level 5
Level 4: Practical use and knowledge beyond School's Mathematics Programme at its Level 6, Level 7

3.3 Location
Level 1: Consistent with School's Mathematics Programme at its Level l
Level 2: Beyond the expectations of School's Mathematics Programme at its Level 2, Level 3 e.g. use of Vic/Aust maps. Computer use/access required.
Level 3: Consistent with School's Mathematics Programme at its Level 4, Level 5. Note computer use/access
Level 4: Consistent with School's Mathematics Programme at its L6, L7. Note computer use/access

3.4 Shapes
Level 1: Consistent with School's Mathematics Programme
Level 2: Pushes knowledge beyond the expectations of School's Mathematics Programme at its Level 2, Level 3.
Level 3: Greater vocabulary required than School's Mathematics Programme at its Level 4, Level 5
Level 4: Knowledge used in a different way therefore not generally covered in the School's Mathematics Programme at its Level 6, Level 7

3.5 Transformation
Level 1: Consistent with School's Mathematics Programme at its Level 1
Level 2: Reasonably consistent with School's Mathematics Programme at it Level 1, Level 2, Level 3
Level 3: Consistent with School's Mathematics Programme at its Level 4, Level 5
Level 4: Requires detailed knowledge/understanding therefore beyond-the School's Mathematics Programme at its Level 6, Level 7

4.1: NUMBER STRAND

Summary: Each sub-strand is covered in the School's Mathematics Programme but the CSF requires greater depth of understanding and/or practical application than outlined in the School's Mathematics Programme many instances such as problem solving, number limits, details of processes. Note: Some of these issues have been addressed by the school's own checklists.

4.2: Numbers, counting and numeration

Level 1: Generally extends the requirements- not covered in the School's Mathematics Programme

- Zero as a number
- Models of numbers to 10 including zero
- Estimate the size of collections to 20
- Comparing several collections up to IO

Level 2: Generally extends the requirements - not covered in the School's Mathematics Programme

- Count by 100 to 1000 (School's Mathematics Programme only 110 although checklists extend)
- Count backwards by lO's, lOO's
- Odd even numbers
- Ordering to 999
- Make, name, record, rename to 999 (School's Mathematics Programme only 110 although checklists extend)
- Estimate large numbers by regrouping items (implied in School's Mathematics Programme)

Level 3: Consistent with School's Mathematics Programme except School's Mathematics Programme only requires 4 digits (extended in our checklists)

Level 4: Pushes through to Level 8 of the School's Mathematics Programme in most outcomes except no match with:

- Compare, order decimal fractions with unequal number of places e.g. 3.05, 3.001 3.4, 3.12
- Fractional parts of discrete collections/quantities e.g. 3/5 of a class of 20

4.3: Mental computation and estimation

Note: Estimation is not pushed in the School's Mathematics Programme to the degree it is in the CSF.

Level 1: Generally extends the requirements - not covered in the School's Mathematics Programme

- Recall automatically and use of doubles to 10 e.g. 4+4
- Use of materials and models in part/whole understanding cg 6=3+3, 6=4+2

Level 2: Generally extends the requirements - not covered in the School's Mathematics Programme

- Auto recall fact to 20, doubles to 20
- Calculate mentally doubles/near doubles to 10

- Rounding to estimate (+, -) to 100

Level 3: Consistent with School's Mathematics Programme but details of strategies used is beyond the depth of materials/understandings used in the School's Mathematics Programme. Treats all times tables cf School's Mathematics Programme .

Level 4: Most outcomes consistent with School's Mathematics Programme at Level 6, Level 7, Level 8 - not covered

- Recall and automatically use + and - facts with well known equivalent fractions e.g.112+114=314, 112-114=1/4

4.4 Written computation

Level 1: Consistent with School's Mathematics Programme which uses ordinal numbers as well

Level 2: Covered by School's Mathematics Programme

Level 3: Consistent - not covered

- Power of 10
- Formal division 3 digits by I digit
- Equivalent number statements 7=4= 14-3

Level 4: Consistent with Level 6 to Level 8 - not covered.

- Compare various methods e.g. lattice multiplication

4.5: Applying numbers

Level 1: Consistent with School's Mathematics Programme

Level 2: Consistent with School's Mathematics Programme

Level 3: Consistent with School's Mathematics Programme but CSF requires more in decimal notation than the School's Mathematics Programme

Level 4: School's Mathematics Programme does not clearly define problem-solving strategies. (Note School's own Checklists).

- Depth of knowledge and ability levels in CSF greater than in the School's Mathematics Programme

4.6: Number patterns and relationships

Level 1: Consistent with School's Mathematics Programme

Level 2: Consistent with School's Mathematics Programme but CSF gives greater emphasis to:

- Doubling
- Testing rules
- Patterns in number charts
- Equations about a particular number

Level 3: Basically consistent but more depth required than the School's Mathematics Programme - not covered:

- Brackets
- Triangular numbers

Level 4: Basically consistent but detail missing (often implied), not covered:

- Expressed rule for detailed number sequences (e.g. Fibonacci)

5.1: MEASUREMENT STRAND:
Summary: The measurement area is well covered in the School's Mathematics Programme with only minor omissions or variations.

5.2 Choosing units:
Level 1: Consistent with School's Mathematics Programme
Level 2: Consistent with School's Mathematics Programme
Level 3: Consistent with School's Mathematics Programme
Level 4: Not covered in the School's Mathematics Programme at all - approach in the CSF more related to problem solving area.

5.3: Measuring
Level 1: Consistent with School's Mathematics Programme
Level 2: Consistent with School's Mathematics Programme
Level 3: Consistent with School's Mathematics Programme except for angles and capacity
Level 4: Consistent with School's Mathematics Programme except for using cubes as a measure of volume

5.4: Estimating
Level 1: Consistent with School's Mathematics Programme
Level 2: Consistent with School's Mathematics Programme
Level 3: Consistent with School's Mathematics Programme
Level 4: Consistent with School's Mathematics Programme in perimeter and length but not for volume, area, mass, money

5.5: Time
Level 1: Consistent with School's Mathematics Programme
Level 2: Consistent with School's Mathematics Programme
Level 3: Consistent with School's Mathematics Programme not covered schedules
Level 4: Consistent with School's Mathematics Programme

5.6: Using relationships
Level 1: Consistent with School's Mathematics Programme
Level 2: Consistent with School's Mathematics Programme
Level 3 Consistent with School's Mathematics Programme
Level 4: Consistent with School's Mathematics Programme

6.1: CHANCE AND DATA STRAND:

Summary: The data part of this strand is well covered in the School's Mathematics Programme with greater expectations in the School's Mathematics Programme at Level 4 of sub strand 6.3 than the CSF requirements. There is some greater requirement in diagram usage at Level 4 in sub strand 6.5 in the CSF. The use of computers for work with databases in Level 3 and Level 4 in sub strands 6.4 and 6.5 will require children in those areas have much better access to computers than is currently available. The Chance component of this strand is only marginally covered in the School's Mathematics Programme with some work on probability at the higher levels.

6.2: Chance
Level 1: Not covered by the School's Mathematics Programme
Level 2: Not covered by the School's Mathematics Programme
Level 3: Not covered by the School's Mathematics Programme
Level 4: Not covered by the School's Mathematics Programme

6.3: Posing questions and collecting data
Level 1: Consistent with the School's Mathematics Programme
Level 2: Consistent with the School's Mathematics Programme
Level 3: Consistent with the School's Mathematics Programme
Level 4: Consistent with the School's Mathematics Programme (School's Mathematics Programme expectations greater)

6.4: Summarising and presenting data
Level 1: Consistent with School's Mathematics Programme
Level 2: Consistent with the School's Mathematics Programme
Level 3: Consistent with the School's Mathematics Programme
Level 4: Consistent with the School's Mathematics Programme - Databases needed to enter class data (easier access needed)

6.5: Interpreting data
Level 1: Consistent with School's Mathematics Programme
Level 2: Consistent with School's Mathematics Programme
Level 3: Consistent with School's Mathematics Programme
Level 4: Consistent with School's Mathematics Programme but range of diagrams (Venn, tree, arrow) not be covered in School's Mathematics Programme. Databases needed to extract information from class databases (easier access to computers needed)

8.1: MATHEMATICAL TOOLS AND PROCEDURES STRAND

Summary: This strand attempts to cover areas of mathematical knowledge, tools and procedures that do not sit easily in other areas of the outcomes model. They are often concepts, ideas and knowledge that is acquired and then needs to be re-in forced through a spiral approach i.e. revisited, revised and encouraged over time to ensure that they are not lost. Some concepts are consistent with the School's Mathematics Programme but others are beyond the scope of the School's Mathematics Programme or are implied and have relied on teachers o instinctively teach them.

8.2 Mathematical tools
Level 1: Calculators not required in School's Mathematics Programme
Level 2: Calculators used mainly for checking in School's Mathematics Programme
Measurement consistent with School's Mathematics Programme
Computer use limited - access a problem at School's Mathematics Programme
Level 3: Rounding off consistent with School's Mathematics Programme
Measurement consistent with School's Mathematics Programme
Decimal use not as detailed in School's Mathematics Programme
Level 4: Measurement consistent with School's Mathematics Programme
Calculator use more detailed in CSF (memory, brackets, negative numbers,
Overflow displays, division remainders)
Databases - limited access to computers!

8.3: Communicating mathematics

Level 1: Consistent with School's Mathematics Programme expectations in number, space and measurement

Level 2: Location/direction consistent with School's Mathematics Programme
More than/less than consistent with School's Mathematics Programme
Describe data collections consistent with School's Mathematics Programme
Spatial terms beyond School's Mathematics Programme

Level 3: 4 operations - consistent with School's Mathematics Programme
Measurement language
Spatial language- " "
Every day/maths language difference - beyond School's Mathematics Programme
Appropriate use of language - beyond School's Mathematics Programme

Level 4: Geometrical language - beyond School's Mathematics Programme
No patterns, operations, symbols, formal units, data interpretation - consistent School's Mathematics Programme

8.4: Strategies for mathematical investigations.

Level 1: beyond stated School's Mathematics Programme (number) - depends on teacher ability/awareness

Level 2: beyond stated School's Mathematics Programme (number)

Level 3: implied but not stated in School's Mathematics Programme (number) - dependent upon teacher awareness

Level 4: implied but not stated in School's Mathematics Programme (number) - " " "

8.5: Mathematical reasoning,

Level 1: consistent with School's Mathematics Programme

Level 2: consistent with School's Mathematics Programme but not stated

Level 3: consistent with School's Mathematics Programme but not stated

Level 4: consistent with School's Mathematics Programme but not stated

8.6: Contexts for mathematics

Level 1: consistent with School's Mathematics Programme

Level 2: consistent with School's Mathematics Programme except for chance component

Level 3: not covered in School's Mathematics Programme except for Roman Numerals and as interest topic with some teachers

Level 4: not covered in School's Mathematics Programme

Mathematical Tools and Procedures: Areas needing additional input, resources etc....

Note: Levels here denote CSF: levels

8.2 Calculators (Level 1, Level 2, Level 3)
Computer databases (Level.4) - computer access needed in the classroom

8.3 Spatial awareness (Level 2, Level 3) geometrical language (Level 4)
Every day use of mathematical words (Level 3)
Mathematical words in non-mathematical situations (Level 4)

8.4 Test by trial (Level l) clarify, test, explore (Level 2)

Strategies etc (Level 3, Level 4) implied but dependent on teacher skill/awareness

8.6 Chance component needs addressing at all levels (not treated in School's Mathematics Programme) Early devices, cultural, historical systems/games etc (Level 3) - not covered in School's Mathematics Programme Alterative methods, cultural/family difference in mathematical knowledge/ideas (Level 4) not treated in School's Mathematics Programme