MATHEMATICS

Seventh-day Adventist
Secondary Curriculum

A Curriculum Framework for Seventh-day Adventist Secondary Schools

Mathematics

Curriculum Framework

Third Edition June 2000

ACKNOWLEDGEMENTS

The South Pacific Division Curriculum Unit has enlisted the help of a number of teachers in preparing this document. We would like to thank all who have contributed time, ideas, materials and support in many tangible and intangible ways. In particular, the following people have helped most directly in the writing and editing of this document:

First Edition 1990

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Alastair Stuart	Longburn Adventist College
Steve Walker	Carmel Adventist College
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Robert Wareham	Nunawading Adventist High School
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Second Edition 1999

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Third Edition 2000

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It is our wish that teachers will use this document to improve their teaching and so better attain the key objectives of Seventh-day Adventist education.

Sincerely

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June 2000
Third Edition

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SECTION 1

Introduction

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1.1 what is a Framework?

A Framework

In the Adventist secondary school context, a "framework" is a statement of values and principles that guide curriculum development. These principles are derived from Adventist educational philosophy which states important ideas about what Seventh-day Adventists consider to be real, true and good.

A framework is also a practical document intended to help teachers sequence and integrate the various elements of the planning process as they create a summary of a unit or topic.

The framework is not a syllabus.

The framework is not designed to do the job of a textbook. Although it contains lists of outcomes, values, and teaching ideas, the main emphasis is on relating values and faith to teaching topics and units.

Objectives of the Framework

One objective of the framework is to show how valuing, thinking and other learning skills can be taught from a Christian viewpoint. The Adventist philosophy of Mathematics influences this process.

A second objective is to provide some examples of how this can be done. The framework is therefore organised as a resource bank of ideas for subject planning. It provides ideas, issues, values and activities to teach these.

The framework has three target audiences:

1. All Mathematics teachers in Adventist secondary schools.
2. Principals and administrators in the Adventist educational system.
3. Government authorities who want to see that there is a distinctive Adventist curriculum emphasis.

1.2 Using the Framework

Before attempting to use this document for the first time, it is suggested that you read through this whole framework.

Notice that the framework is comprised of the following:- explanation of a framework and its use, philosophy and objectives, suggestions on how to plan units of work, key planning elements, examples of topic plans, lists of important ideas, values, issues, teaching strategies, and other elements which are useful in building a planning summary.

These components are grouped into five sections. The nature and purpose of each section are set out below.

Section 1 – introduction

Section one sets out the purpose of having a framework. It explains what a framework is and shows how to use it in a teacher's program and on a regular basis to enhance one's teaching and make it more Christian oriented.

Section 2 – philosophy

This is the philosophical section. It contains a philosophy statement, a rationale (a statement of the value base for teaching mathematics), and a set of objectives which have a Christian bias.

This section is meant to help teachers refresh their memories of the Christian perspective they should teach from. They may consult this section when looking at longer-term curriculum planning, and when thinking about unit objectives. They may also consider the adapting it or using it to form part of their program of work.

Section 3 – planning a unit of work

Section three is of the "how-to" section of the framework. It explains procedures teachers can follow when planning an overall course, topic, or unit of work while thinking from a Christian perspective. It ends with sample units of work compiled after working through the steps. Because it suggests ideas for integrating knowledge, values and learning processes in teaching, this section is the heart of the document.

Section 4 – planning elements

This section contains the various lists of ideas, values and teaching strategies that teachers may consult when working their way through Section three of the framework. It is a kind of mini dictionary of ideas to resource that steps followed in Section three.

Section 5 – appendices

Section five contains ideas for teaching that may lie outside the immediate context of the classroom. It assists teachers in explaining in more detail some of the more specific ideas and approaches presented in this framework. It examines the meaning of values and how a Christian should approach values in mathematics, both of which are useful as reminders of good teaching and learning practice.

SECTION 2

Philosophy

INDEX

2.1 a philosophy of mathematics

Everywhere in nature there are evidences of mathematical relationships. These are shown in ideas of number, form, design and symmetry, and in the constant laws governing the existence and harmonious working of all things. Through its study of these laws, ideas and processes, mathematics can reveal some of God's creative attributes, particularly His constancy.

Whereas the student cannot comprehend the absolute unchangeable nature of God, mathematical dependability demonstrates clearly the consistency of God and His perfect creation. This is a demonstration of total dependability.

Mathematics may also develop students' capacity to use appropriate thought processes to more clearly identify aspects of truth which relate to natural laws and design. Such truth is predictable, in that given a set of axioms and the appropriate mathematical processes, the result is always as expected. Therefore when students learn mathematical processes, axioms and laws, they may be further enabled to more clearly identify God's design and handiwork in nature.

While mathematics is a pure science, allowing many hypotheses and conjectures to be conclusively demonstrated as being either correct or incorrect, it also opens possibilities of knowledge that defies either proof or disproof. Examples are infinite smallness and infinite greatness. This unusual balance between the unexplained and the clearly evident provides the student with an accurate picture of an infinite and eternal God, whom we can neither prove nor disprove, yet in whom we believe. However, God has created rules and functions that can be demonstrated as an evidence of His presence.

As the language of the universe, mathematics helps show us how God is made manifest there. It expresses this part of God’s quality in its patterns of space and number that are partly aesthetic and spiritual. The spiritual dimension of mathematics transcends logic and reason. It asks ultimate questions, reveals the marvels of human imagination, presents amazing ideas, and changes the way we think about the world.

2.2 rationale

There are many reasons why students should learn mathematics.

Firstly, they need to master basic mathematical skills in order to cope with the demands of life. Such demands include being numerically literate, gaining the tools for future employment, developing the prerequisites for further education, and appreciating the relationship between mathematics and technology.

Secondly, mathematics is the language of the sciences, and many disciplines depend on this subject as a symbolic means of communication.

Thirdly, a particularly important life skill is decision-making. Mathematics education can play an important part in developing students' general decision-making and problem solving skills.

A fourth justification for learning mathematics is the need for students to use the subject as an important means of discovering truth. The discipline clearly and precisely presents aspects of knowledge which are helpful in finding out truth about the structure and patterns of the environment, and of some of the ways in which God has communicated with man.

The fifth reason for studying mathematics is closely associated with the quest for truth. It is that mathematics assists our search for beauty. Students develop their aesthetic aptitudes by looking at patterns in nature and by appreciating the precision and symmetrical beauty in God's creation.

The sixth justification for mathematics is that it is an important aid in developing the creativity of the individual. Here the student has limitless opportunity to test his skills against the immutability of God's law. In a very real sense the student will develop confidence as he or she examines the consistency of law.

2.3 mathematics objectives

The study of mathematics aims to enable students to:

Christian Worldview

1. Develop willingness to perceive the spiritual dimension in mathematics.

2. Develop an awareness that mathematical order and precision are characteristic of God the Creator.

3. Develop a growing knowledge of God's faithfulness and dependability through studying mathematics as a language of the universe.

4. Develop the ability to make links between mathematical concepts and other aspects of experience, whether these aspects are largely intellectual, practical or spiritual.

5. Develop the ability to identify values and make value judgments about mathematical ideas and quality.

Attitude to Mathematics

1. Perceive mathematics as a living art, one which is intellectually exciting, aesthetically satisfying, and relevant to applications which help meet life needs.

2. Develop a positive, adventurous attitude to learning mathematics, which includes enjoyment of learning.

3. Appreciate the value of calculating devices in mathematics.

4. Develop a positive set of emotional competencies through learning mathematics. Examples are self-discipline, self-confidence, patience, and courage.

Learning of Mathematics

1. Use mathematics in coping with, controlling and determining factors which will influence their present and future environments.

2. Maintain and increase their range of basic mathematical skills.

3. Develop the ability to communicate using the symbolism and procedures of mathematics.

4. Develop competence in applying mathematics in a wide variety of life situations.

5. Develop the skills of logical thinking and presentation.

6. Develop the synthesis skills of using techniques from different areas of mathematics to solve a problem.

7. Develop skills in talking, listening, reading and writing about mathematics.

8. Support other fields of study which make use of mathematical techniques.

SECTION 3

Planning a Unit of Work

3.1 steps IN PLANNING units AND LESSONS

When planning courses, units and lessons, there are some essential planning elements to keep in mind. Suggestions for going about the planning process are set out below.

On the following pages there are examples of how unit plans may appear in work programs.

A Overview

1. Read government requirements to find the syllabus requirements, content to cover, objectives, scope and sequence. These will be unique to each state, although there will be some degree of similarity in junior school with the recent moves towards a national core outcomes-based curriculum.

2. Fit the topics to the school calendar and weekly timetable to create units of work. Take into account public holidays, exam blocks, revision time for tests/exams, school camps, sporting days, school photos, competitions, known excursions, and any other form of known interruption. It is always best to gain the yearly picture to determine what can and cannot be covered for the teacher's as well as the student's sanity. Ensure topics are not rushed by allowing some extra time every so often. By doing this, unexpected events such as excursions can be compensated for and one's anxiety will be reduced.

B Composing a Topic

1. Gather information on the topic, including possible texts and resources. Contact your local Education Department, especially the subject Curriculum Development Officer. Ring other schools in your district and talk to teachers in your subject area. Most teachers are more than willing to help.

2. Refer to Section 4 for outcomes in each of the four areas of knowledge, skills, higher processes, and values that you could incorporate into your unit of work. Section 3.2 has sample units of work. Try to compose your unit of work from a Christian framework.

3. Start to think about the main assessment tasks of the unit. Think beyond the standard test. Try to cater for individual differences in assignment. In Section 4.5 you will find a range of ideas.

4. Break the information into lessons with appropriate time for the elements to be covered each lesson. Allow time for activities (in or out of the classroom), for possible research or computer time, and for revision.

5. Sequence the lessons with appropriate links between them.

C Individual Lessons

1. List the most important outcomes. Knowledge outcomes include content, and the concepts and worldview of mathematics. Skills outcomes describe abilities that follow knowledge and practice. Higher Processes include elements of processes such as inquiry, problem solving and data processing. Values are of many kinds. See .those in Section 4.1. Some are teachable more directly and others are taught less directly by exposure and experience. Some are assessable, and some are not.

2. Determine how these outcomes (knowledge, skills, higher processes, values) will be achieved.

3. Devise interesting teaching strategies and look for supporting resources.

4. Create and refine teaching notes.

D Post Lesson Planning

1. Evaluate during and after teaching. Make notes where you can improve for next time.

2. Modify future teaching.

3.2 Sample Units of Work

YEAR 10 — THE ODDS ARE AGAINST YOU (PROBABILITY)

Time: Four forty-five minute periods

Outcomes	Content Sequence	Possible Activities	Possible Assessment
Knowledge Recall the concept of odds Recall terms associated with probability Define probability **Skills** Calculate odds Demonstrate the probability of success/failure using odds Construct tree diagrams Accurately perform probability calculations using a calculator where appropriate **Higher Processes** Calculate the probability of compound events Translate written problems into mathematical symbols Solved problems involving probability **Values/Ideas** Apply knowledge skills to show the futility of gambling Show awareness of the importance of good stewardship Avoid taking unreasonable risks which make chance the basis of conduct	Introduction: Christian view of probability and gambling Revision of probability terms: trial, experiment, outcome, probability, relative frequency, sample space, random experiment, certain event Definition of probability Calculation of probability Definition and calculation of odds Converting the probability of success into odds Calculating the probability of compound events Drawing tree diagrams Revision	•Rolling a die/dice a number of times •Spinning tops •Drawing cards from a pack •Drawing marbles from a bag	•Probability project on odds •Unit test

YEAR 10 — STATISTICS

Time: 12 forty-five minute periods

Outcomes	Content	Possible Activities	Possible Assessment
Knowledge Explain the meaning of terms used: Describe the scope of the use of statistics as set out in the unit **Skills** Sample a population to make estimates Graph statistical data Show frequency distribution Calculate mean, median, mode Calculate standard deviation Predict using statistics **Higher Processes** Process complex data Use statistics to critically evaluate information Think about the truth or merit of statistical information Communicate statistical trends Inquire about statistical validity and truth Make intelligent decisions using statistics **Values/Ideas** Make wise choice when using statistics Verify statistics to clear up wrong perceptions Critically evaluate statistics Understand the place of individuals in calculating means	**Skills** Sampling Graphing Frequency distribution Mean, median, mode Standard deviation Use of statistics in everyday life **Processes:** Data processing Calculation Thinking Communication Inquiry **Values:** Honesty in using figures, quotes and calculations Truthful presentation Positive acceptance of the reality of statistics Caution in prediction Wisdom in decision-making	•Survey how choices are made •Illustrate how statistics can be used to clear up misperceptions of products •Graph examples of misleading statistics to show reality Graph and compare statistics on a “quit now” program and a tobacco advertising program •Work sheet to show how taking mean, median and mode can lead to a different interpretation of statistics and incorrect decisions •Use a bell curve to illustrate the idea that on any issue we should expect extremes, and a range of behaviours and beliefs •Relate uniqueness to extremes, bell curves and peer pressure	•Presentation of survey data •One graphing assignment •Unit test

SECTION 4

Planning elements

4.1 Ideas for teaching mathematics in a Christian context

A Teach the Idea of Quality

Remembering that God's quality is the foundation of Christian reality, teachers can cmphasise the idea that mathematics teaches particular aspects of this quality. This helps bring together the Christian and mathematical worldviews.

Consider the following ideas about how mathematics expresses the quality inherent in the space and numbers of the universe.

3. Mathematics is the science of space and number. Space and number have important value in themselves, and help create the quality of our life.
4. Mathematics is a language that describes the properties of the universe. Through it we better understand the quality and reality of the created universe.
5. Mathematics is a numerical pattern of values.
6. Mathematics requires rigorous thinking about number, axioms, laws etc. This is a kind of intellectual quality.
7. Mathematics helps us understand and use science and technology. These in turn add quality to daily life.
8. Aesthetic quality is shown in number patterns.
5. Mathematics gives us quality of understanding about the world — a clearer world view

BTeach Values

1. Types of Values

Types of values that are derived from the reality of Mathematics are listed below. Although the values are categorised in a particular group, many could be placed in several categories.

Aesthetic Values

6. Appreciation of a Designer
7. Awe of the imagination beauty and power of mathematics
8. Balance in mathematical properties and design
9. Economy of design in nature
10. Elegance of a solution
11. Harmony in design and beauty
12. Mathematical harmony in music
13. Order of numerical patterns and working
14. Sense of beauty

Application to Life Values

1. Ability to apply mathematics - in managing money, going shopping, calculating dimensions of things etc
2. Appreciation of the practicality of mathematics

Creativity Values

1. Ability to design
2. Ability to see and create problems
3. Flexibility
4. Originality in solving problems

Emotional Values

1. Desire to develop one's ability
2. Perseverance
3. Positive attitude to mathematics
4. Positive sense of self-worth
5. Positive use of difficulty and failure

Intellectual Values

- Ability to arrange priorities
- Ability to make good choices and decisions
- Acceptance of paradox
- Accuracy
- Application ability
- Appreciation of inquiry in learning
- Awareness of choices and their consequences
- Awareness of the potential of mathematics
- Care in work
- Caution in interpretation of data
- Clarity of reasoning process
- Disciplined memory
- Disposition to learn from mistakes
- Disposition to search
- Economy of working method
- Economy in use of resources
- Logic
- Open mindedness
- Perspective of the certainty of mathematical ideas and laws
- Predictability of mathematical laws
- Progressiveness
- Responsibility for quality
- Stewardship of resources, time and effort
- Verification of procedures and results

Social Values

5. Appreciation of human mind and imagination
6. Appreciation of the inner logic of mathematics
7. Awe of the power and beauty of mathematics
8. Disposition to find evidences for God
9. Interest in asking ultimate questions such as "what is finite and infinite?"
10. Reference to ethical principles
11. Wonder about properties of space and number

Section 4.3 lists many mathematical topics and identifies values that could be communicated in those topics.

2. Tactics for Teaching Values

- Identify values involved in problems and examples. An example is the value of stewardship which is careful budgeting, and the responsible use of funds through credit cards etc. When we are teaching aspects of how mathematics affects consumers, we may emphasise the importance of stewardship.

- The making of choices and decisions is an important part of valuing. We can emphasise the idea that mathematics involves many decision-making situations. For example students make choices about the best procedures to solve problems. We may refer to the consequences of making such decisions, and ways of verifying that these consequences will occur.

- An extension of Point 2 is to teach the idea that in mathematics we make value judgements about the worth of problem solutions or procedures we use. In this kind of situation we are focusing on quality in our working procedures. This kind of quality is also linked to intellectual values such as accuracy and clear logic

- Look for opportunities to teach values in appropriate topics. An example of a values-oriented topic is how mathematics influences beauty and design in nature.

- Consciously model what it is to be a mathematician of quality. Such modeling includes personal ethics, the approach to doing mathematics, and social interaction.

- Teach attitudes to being a good scholar in classroom procedures and interaction.

CTeach About Wonder and Spirit

Mathematics is more than reason. Like many other forms of knowledge, it has a spiritual dimension. Teachers can start to point students to this dimension by using opportunities to mention aspects of mathematics that are potentially spiritual in nature. Examples:

- Mathematics reveals remarkable feats of human imagination that go beyond common sense and immediate reality. This means they can “transcend” in one kind of spiritual sense.
- Mathematics is deeply human because it shows the marvels of the human mind in operation. Our humanity is itself a thing of awe.
- Mathematics is spiritual because it asks ultimate questions such as “what is finite and infinite?”
- Mathematics is a thing of wonder because it is essentially the language of the universe.
- Mathematics is astonishing because it presents amazing ideas such as negative numbers.
- Mathematics is majestic and powerful because it has an inner logic that looks as if a single intellect is in operation when developing mathematics, when in fact there are many.
- There is spiritual quality in human awe and wonder about properties of space and number.

D Make Links Between Math's Concepts, Experience and the Christian Worldview

Teachers can make links between the concepts of mathematics and aspects of experience. Major mathematical concepts include infinity, equality, and uncertainty.

Linkages can be made by using analogies, parallels, comparisons and object lessons. The following examples illustrates this strategy.

One concept is infinity. The idea of infinity is a concept, not a number. It is something that has no limits, and which is unbounded or unreachable. The unknown infinite "nothings" of mathematics are turned into something through calculus. One example from the natural world is the idea of "cosmos."

Another concept is balance. Solving equations always requires them to be balanced. An unbalanced or messy sequence ends in the wrong answer. In reference to life, imbalance can result in an unhealthy lifestyle. Also, a satisfying Christian life always requires a balance.

A question format can help this linkage process. An example of using a question is:
- Is infinity a concept or a number?
- In what ways is infinity a metaphor for your concept of God?

It is important to recognise that some links in this process are inherent and others analog. To illustrate, the concept of "logarithms" models the way we respond to the intensity of sounds. This is an inherent link between mathematics and experience.

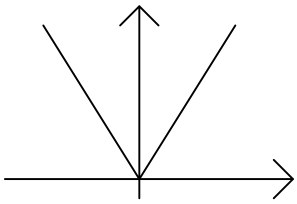
By contrast there is an issue of "Christmas" being abbreviated as "Xmas." We may think about the idea that the "X" in "Xmas" can be seen as an unknown like an "x" in an equation. To use an indirect analog link, we could say that Christmas has changed its focus, no longer with the focus being on "Christ", so that it has also become an unknown.

The aim in this kind of process in this framework is to provide teachers with ideas, yet at the same time to avoid derision for being simplistic or too ambitious. It is important not to claim too much when making links between the mathematical worldview and the Christian worldview.

The next six pages give more inherent and indirect links between ideas and values of mathematics, and the Christian worldview.

E Make Links Between Values and Christian Worldview

This section of the framework attempts to show how teachers can make links between mathematical concepts and values and ideas that are found in life's experience, and that are often outside mathematical study. Some of the key concepts of mathematics are set out below in table form to align each concept with its possible applications.

Concepts	Applications
Absolute Value	
Absolute Value 	**Inherent Link** **Indirect Links** God is absolute God turns negatives into positives Quadratics – frowns can be turned into smiles
Comparisons	
Equations and inequations Balance Opposites Greater than and less than Inverses Real and unreal Terminating and non-terminating decimals Digital and analog	**Inherent Links** Discrimination involves comparison Conservation laws and their limits (mass/energy) show boundaries between variables and invite comparison Value equivalence rather than "appearance" may better express identical properties **Indirect Links** Good and evil can compare with infinite and finite Real and unreal can compare with love and hate Truth and error are opposites Conditional equality can depend on circumstances Value – God's idea of value is different from ours Comparison between the transition from OT and NT and progress in personal development

Concepts	Applications
Data Qualitative and quantitative Statistical procedures Sampling Graphs Numbers Organisation Estimation Simulation Statistical measures Normal curve	**Inherent Links** Each piece of information has equal significance Honesty in representation of data is important **Indirect Links** One person as a single entity can make a difference Life on this earth is only a sample of the real Christian life still to come
Infinity Has no limits, unbounded, unreachable A concept, not a number Can refer to number lines (big, or small) The unknown Related concepts – fractions, decimals, asymptotes	**Inherent Links** Infinite “nothings” are turned into something from calculus One example from the natural world is the idea of “cosmos” **Indirect Links** Infinite can be “inside” finite. An example is incarnation (a finite God in a finite body) It is one of the different metaphors for God It can relate to God’s beginning or end It does not reduce God but increases understanding of him It can express time and the relationship to God

Concepts	Applications
Logic Way of thinking and doing Order of operations Provides linkage between ideas (eg reasoning/setting out) Undergirds laws of Mathematics Depends on suppositions and assumptions Includes proofs and induction Has conventions Grouping of lie terms	**Inherent Links** Logic shows the juxtaposition of design and chance Logic expresses conventions versus absolutes Fairness relates to logic **Indirect Links** There is choice in logic as in salvation There are arbitrary human limits to logical limits The brain has a self-organising function relating to logic The brain has a self-organising function relating to logic There is logic in consequences for choices The conditionally for salvation is not logical
Measurement Time Space – length / area / volume Mass and weight Pi Angles Trigonometry Speed/acceleration Estimation Measurement systems Reference points Logarithms Use of aids like calculators and rulers and instruments Limits of accuracy	**Inherent Links** Relativity is a kind of measurement perspective There is relationship between linear time and space Judging involves measuring things like scales and reference points **Indirect Links** Short time gaps such as in God's travelling (eg Gabriel and Daniel) are amazing Concept of spiritual warfare has certain kinds of dimensions Time is ever new, involving decisions and ramifications Omnipresence cannot be measured God not limited by time and space Prayer – how does God cope with the immeasurable? Limited or choice? Destiny – predetermined, measured, God measures Christ rather than us Prophecy and time are related measures Perfection seems immeasurable The relation between design skill and extent of experience is measurable Age of the earth is hard to measure Bible study is an aid to measurement

Concepts	Applications
Number Systems Natural Rational Irrational Real Imaginary and complex numbers Number bases Images Zero Binary Decimals and place value Fractions Sets and subsets	**Inherent Links** Going through operations without understanding does not use the potential of number systems Every set is a subset of something bigger Imaginary numbers have a physical reality **Indirect Links** Small discoveries such as number have made large differences in our lives No persons should feel insignificant because small things like numbers are not God is the universal set Time-based cycles of day, year, month are defined in nature, but where did the week come from? Once a person accepts Christ, experiences become real (like or unlike a number system?)
Patterns Sequences – Fibbonacci; GPs and Aps Fractals Tessellation's Aesthetics Design and design process Spirals Repetitions Modeling Symmetry	**Inherent Links** Examples of patterns: exponential growth and decay; normal distribution; patterns in mathematical functions and their graphs Harmony, beauty, symmetry and patterns abound Patterns of mathematics are numerical value patterns **Indirect Links** The intrinsic value of mathematics is shown by its practical value to people Design implies a designer

Concepts	Applications
Proofs Different types of proofs – contradiction; induction; direct Evidence and example Axioms and theorems	**Inherent Links** Evidence can be internal, not necessarily external The lack of a proof does not mean that something does not exist **Indirect Links** Contrast of evidence and proof is required to allow room for faith God chose to work with evidence, not proof Proof by Mattner re conversation with God – still have to accept him at his word
Proportions Ratios Aesthetics Design Dimensions Direct/indirect variation Inverse variation Fractions and percentages	**Inherent Links** Aesthetics, the sense of the beautiful contains proportions Present in design in nature such as in the Fibbonacci series Inverse square laws show proportion **Indirect Links** Creativity depends on design and variation Human perception is not necessarily accurate
Similarity/Congruence Similarity Equivalence Reasons for congruence Grouping of like objects	**Inherent Links** **Indirect Links** Man's likeness to God Race, language, and philosophy have congruence There is congruence between mathematics and world view

Concepts	Applications
Transformations Translation Rotation Reflection Symmetry Enlargement Shear Matrices and vectors Objects and images	**Inherent Links** **Indirect Links** Transformation of a life parallels mathematical transformations Reflection of Christ a transformation Incarnation is a transformation Perception can involve transformation Turning a life around – conversion is transformation God is required for direction, enlargement, translation in life
Uncertainty and probability Chaos Chance Sequences Complement Confidence intervals Predictability Margins of errors Odds Binomial Theorem Probabilities of zero and one Dependent and independent events Qualitative and quantitative	**Inherent Links** Decision-making draws on probability **Indirect Links** Beliefs about life views involve probability Certainty of beliefs such as about religious salvation relate to probability Creation and evolution debate the probability of one kind of beginning over another Gambling with probability involves stewardship God’s existence has probability God’s involvement in things that seem to have no rhyme or reasons expresses uncertainty or probability Parable of the sheep and the goats expresses probability Pascal’s Theorem weighs up the probability of God Success or failure are the only two probability options in some aspects of life

Concepts	Applications
Variables Express abstract quantity Representations of something else Provide the ability to generalise Subject to laws and boundaries	**Inherent Links** Variables express an unknown quality Variables help us derive an understanding or appreciation for something initially not known **Indirect Links** The abbreviation Xmas rather than *Christmas* shows representation of the spiritual unknown in the actual event Christ's representatives on earth are variables We are subject to natural laws like variables are

F Use Biographies to Teach Values, Concepts and Wonder

The lives of mathematicians provide opportunities to teach values. Consider the following example of how biography can be used to introduce values and worldview ideas.

The issue of how we gain certainty about what is real raises the question of what really lies at the heart of maths. For example Robert Pirsig has explained how the Frenchman Poincare changed his ideas about the nature of maths. He was puzzled by Euclid's fifth postulate that said that through a given point there's not more than one parallel line to a given straight line. He saw that Lobachevski had refuted this postulate as impossible and set up his own geometry which was as good as Euclid's. Then he noted that Riemann appeared with another unshakable system which differed from both Euclid and Lobachevski. An "aha" experience happened when contrary to his previous thinking he realised that his system of mathematical functions called the "Theta-Fuchsion Series" was identical with non-Euclidian geometry.

Poincare concluded that the axioms of geometry are simply conventions and not proven facts. We choose among them to obtain what suits us if it is advantageous to us. Even concepts such as space and time are only changeable definitions chosen on the basis of their convenience.

He then struggled with questions like "what are the most important facts?" and "how de we choose the best facts?" In the end he decided that mathematical solutions are selected by the subliminal self on the basis of "mathematical beauty" of the numbers and forms, of geometric elegance. He said "this is a true aesthetic feeling which all mathematicians know… but it is this harmony, this beauty that is at the centre of it all" (Pirsig 1974, 270).

Bibliography. Pirsig, Robert. 1974. Zen and the Art of Motorcycle Maintenance. Viking.

4.2 mathematical PROCESSES AND SKILLS

Set out below are a number of processes and skills that could be taught in secondary mathematics courses. The list is not exhaustive, and is meant to help teachers see at a glance a profile of skills that a student would try to develop over time.

PROCESSES
Approximation
Calculation
Communication
Data processing
Decision-making
Estimation
Exploration
Inquiry
Problem solving
Thinking

SKILLS

Calculation
Performing calculations
Substituting
Using a calculator
Verifying results

Communication
Comparing
Comprehending
Describing
Explaining
Following instructions
Neatness
Representing
Setting out
Sketching
Terminology
Writing skills

Data Processing
Classifying
Collating
Collecting data
Organizing information
Presenting
Recording
Summarizing

General
Application
Constructing
Drawing
Graphing
Manipulating
Measuring
Risk taking
Using computers

Inquiry
Investigating
Listing
Multiple references
Seeking patterns

Problem Solving
Analyzing information
Looking ahead
Looking back
Problem discovery
Seeking information
Synthesizing

Social
Accepting responsibility
Contributing
Following directions
Initiative
Listening
Persevering
Tolerance

Thinking
Abstracting
Analysing
Classifying
Comparing
Deducing
Generalizing
Inferring
Synthesizing
Validating
Mental arithmetic
Patterning
Plotting

4.3 OUTCOMES OF MATHEMATICS

KNOWLEDGE

Students should be able to:

1. Recall mathematical facts;
2. Understand and use mathematical terminology;
3. Understand mathematical concepts and relationships;
4. Understand the historical contribution of mathematics to society;
5. Know relevant formulae, equations, rules and theorems and their proofs when appropriate;
6. Know relevant procedures and techniques such as the method of proof by induction;
7. Recall basic shapes of the graphs of the functions and relations used;
8. Understand where mathematics is used in real life.

LARGER PROCESSES

Students should be able to:

1. Access the appropriateness of a particular strategy in solving a problem;
2. Identify and execute the discrete steps necessary to solve a range of practical problems;
3. Translate realistic written and oral problems into mathematical symbols and vice versa;
4. Draw and attempt to justify conclusions or hypothesis in relation to sets of data;
5. Make informed decisions based on a mathematical evaluation of various options;
6. Access the accuracy of results in relation to a given context;
7. Analyse and interpret data;
8. Discover generalisations and express them mathematically.

SKILLS

Calculation

Students should be able to:

1. Develop manipulative and computational skills;
2. Accurately perform calculations, using a calculator where appropriate;
3. Read information expressed in mathematical words and symbols;
4. Substitute in appropriate formulae;
5. Verify the suitability and reasonableness of a result.

Data Processing

Students should be able to:

1. Acquire skills in collecting data from a variety of sources;
2. Develop skills in organising information
3. Practise practical methods of summarising and presenting data;
4. Show facility in drawing graphs and diagrams;
5. Develop systematic ways of recording information.

Inquiry

Students should be able to:

1. Develop investigation and inquiry skills;
2. Acquire skills in using multiple references, and reading widely but selectively;
3. Develop oral and written communication skills, including the ability to use precise terminology;
4. Manipulate concrete materials, mathematical instruments and measuring devices;
5. Develop initiating strategies - seeking patterns, constructing tables, listing.

Thinking

Students should be able to:

1. Translate realistic written and oral problems into mathematical symbols and vice versa;
2. Make informed decisions based on a mathematical evaluation of various options;
3. Understand the nature and role of inductive and deductive reasoning and proof, and reason inductively and deductively;
4. Apply suitable mathematical techniques and problem solving strategies to routine and non-routine situations.

Communication

Students should be able to:

1. Demonstrate basic writing skills;
2. Present work with appropriate setting out and neatness;
3. Clearly understand instructions and follow them.

Social

Students should be able to:

1. Accept responsibility for their own actions;
2. Follow directions;
3. Listen and be tolerant of others' views;
4. Contribute to group discussion and activities;
5. Start work without prompting.
6. Interact in a cooperative manner with peers and teachers.

Emotional

Students should be able to:

1. Develop self-confidence in handling mathematics;
2. Persevere when problems arise;
3. Develop a desire to develop their ability
4. Develop a positive sense of self-worth
5. Be able to make positive use of difficulty and failure

ATTITUDE TO LEARNING MATHEMATICS

Students should be able to:

1. Develop an appreciation of the value of mathematics in society, and apply this appreciation in their everyday contexts;
2. Be willing to experiment mathematically in unfamiliar situations;
3. Show a willingness to participate in the learning of mathematics;
4. Strive for a neat, orderly and logical presentation;
5. Positively affirm mathematics as being intellectually exciting.

4.4 values AND CONCEPTS IN MATHEMATICS TOPICS

This section of the framework extends Section 4.1 Part E. It is designed to give teachers ideas about how concepts and values could be identified and communicated in particular mathematics topics. The values are arranged alphabetically in each topic.

ALGEBRA

Awareness of Consequences:
Indirect link — in equations the value that one substitutes for “x” results in certain consequences. Indirect link — this illustrates the influence of cause and effect in life.

Awareness of Potential:
Indirect link — as in asymptotes, we may become closer and closer to Christ in likeness but never touch Him. Our relationship and potential to grow is continuous and infinite.

Balance:
Inherent link — solving equations always requires them to be balanced. An unbalanced or messy sequence ends in the wrong answer.
Indirect link — a satisfying Christian life always requires a balance.

Caution:
Indirect link — test the solution of an equation to see if it works. Test things in life to see if they are worthwhile.

Certainty:
Inherent link — decision-making draws on probability
Indirect link — Success or failure are the only two probability options in some aspects of life

Choice:
Inherent link — choice is an important part of mathematical reasoning. For example, we plot lines by choosing values for x and y. We choose between values such as speed and completing the task in detail or with accuracy.
Indirect links — many of our choices carry consequences, and we must learn what these are. The analogy holds for many life situations as well.

Development:
Inherent link — an example is that although the positive gradient of functions may vary, all are upwards.

Learning From Mistakes:
Inherent link — if you make a mistake, try to decide what went wrong and do not make the same mistake next time.

Order:
Inherent link — sometimes things need to be re-ordered and sorted out to be useful. Formulae are based on order.
Indirect link — the transposition of equations is like the Christian life, for in life we cannot always see the immediate purpose in something.

Positive Peer Selection:
Indirect link — simplifying by collecting like terms has a parallel with collecting types of peer friends in life.

Positiveness:
Indirect link — when multiplying negative numbers, two negatives give a positive. God turns both positive and negative experiences into positive ones.

ARITHMETIC

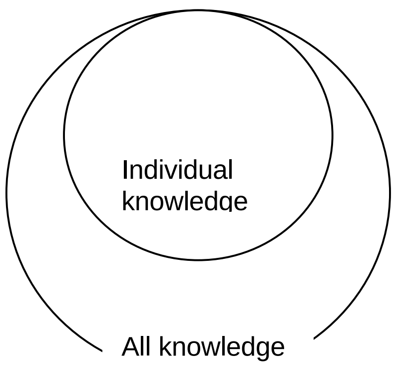
Accuracy:
Inherent link — accuracy implies economy because when we are accurate wastage is minimized. We should strive for care and neatness.

Awe:
Indirect link — counting numbers as an infinite set, as God is an infinite being.

Economy:
Inherent links — mathematics should encourage efficient use of resources such as time, effort, space, materials. Economy includes efficiency in producing results. Clarity of expression is part of economy. Choosing the most effective alternative, involves values such as simplicity, conciseness, and clarity.

Informed decision-making
Inherent link — when making choices, the greater the knowledge, the wiser the decision that can be made. Knowledge is founded on basic skills.

Logic:
Indirect link — note the venn diagram below on how knowledge relates to the existence of God:



The diagram shows that knowledge of the existence of God may exist outside individual knowledge.

Order of numbers:
Inherent link — this can be shown for example in: magic squares, number patterns, Pascal's triangle. Numbers and operations are ordered and wrong answers result if order is wrong.

Place:
Indirect link — in mathematics, numbers have value according to their place (eg the 7 in 372 is worth 70). So in life, many things have value because of their place — place assigns value. We profit from knowing our rightful or appropriate place in many life situations.

Self-worth:
Indirect link — this can be shown by place value. For example the value of a digit is determined by its position in relation to the decimal point. We can let God put the decimal point in our life.

CALCULUS

Economy of Resources:
Inherent link — this can be illustrated by using maximum and minimum values to calculate minimum material needed for maximum volume etc.

Following instructions:
Inherent link — following instructions is being willing to follow set guidelines and rules.

Inquiry:
Inherent link — explores limits, and considers the infinite and the finite.

Logic in Reasoning:
Inherent links — deductive and inductive reasoning are based on logic.
The results of logic are only as dependable as the truth of the original premise.
Two types of reasoning are deductive and inductive:

Mind Expansion:
Inherent link — calculus can be a tool available to attempt problems not solved by previous knowledge.

Positive Use of Difficulty and Failure:
Indirect link — an example of this trait is as follows. The turning point in a graph occurs when $f^1(x) = 0$, so often the turning point in life occurs when we reach our lowest point.

Reference To Principles:
Inherent link — Reference to principles is our derivation of why we do what we do. In calculus we use first principles to explain why we follow a set method, then we just keep using that method knowing in the back of the mind why.
Indirect link — even though we do not always think every action through every time we act, we need to be aware of the basic original reason for doing what we do.

CONSUMER ARITHMETIC

Arranging Priorities:
Inherent link — money is not everything. We should be able to put money into its true perspective.

Economy:
Inherent link — economy refers to the ability to calculate values for wise spending and investing.

Responsibility:
Inherent link — responsibility refers to living within your means.

Sharing:

Inherent link — we should develop the concept of planning to be able to help other people. We should not keep everything to ourselves.

Stewardship:
Inherent link — is budgeting, and responsible usage of funds (credit cards etc). The mathematics of consumerism often stresses the importance of stewardship when making decisions about purchasing goods. For example, students can be shown the importance of comparing prices and looking for the best buy.

Verification:
Inherent link — Verification is the ability to put something to the test, and to check its real value.

Wise Choice:
Inherent link — wise choice is the ability to make informed intelligent decisions about spending.

Worth:
Inherent link — worth demonstrates the value of mathematics in its practical application to living, hence its practical value. Mathematics helps us to live as a more useful citizen in our society.

GEOMETRY

Acceptance of Paradox:
Indirect link — a point is not really a point but a representation of a point. This concept is still very useful and important, and parallels our incomplete understanding of God.

Appreciation of a Designer:
Indirect link — in engineering the strongest shape is a circle — like the trunk of the tree. The tree, designed by God is everywhere in nature.

Design Economy:
Inherent link — the mathematics of the honeycomb shows the economy of design. Economy produces the greatest strength and volume from the smallest amount of material.

Logic:
Indirect link — by deductive reasoning and through observation of the world we can deduce a Creator's hand.

Reasoning Process:
Indirect link — design in nature (logarithmic spiral of nautilus shell or honeycomb) can be used to support the argument for the existence of a Designer.

Utility of Pattern:
Inherent link — the usefulness of pattern is illustrated as follows:

Mathematics expresses the concept of pattern in nature.
There is a high degree of dependability of pattern in nature.
Pattern is a tool for observation, and a tool for analysis.
Pattern is a means for prediction.
Geometrical patterns are the building blocks for both technology and beauty.
Number patterns are the basis of mathematical theories.
Pattern in statistics enables prediction and forecast with a high level of dependability.
Probability is sometimes observation of pattern.

MEASUREMENT

Accuracy:
Inherent links — accuracy is something we should always strive for. The limits to accuracy of results are dependent on the limits of the original measurements. We must recognize types of errors. Two types are: avoidable which include systematic errors such as parallel, transcription errors; and unavoidable which depend on factors such as the level of accuracy of measuring instruments. We may strive for accuracy, but we should recognize its limits.

Choice:
Inherent link — choice is using correct and reasonable units of measurement, and a suitable level of accuracy for different situations.

Disciplined Memory:
Inherent link — formulae **must** be learned. It takes **effort** to learn some things.

Economy
Inherent link — economy is being able to calculate requirements that are needed, and to save wastage.

Finding God
Indirect link — as with measurement where we do not need one hundred percent accuracy for it to work, we do not need to understand everything about God for Him to work for us.

Open mindedness
Inherent link — we should not take the first or most obvious measurement for granted, but we should consider other possibilities before starting our problem solving.

Practicality:
Inherent link — there is a practical use in measurement, yet there is not one hundred percent certainty or accuracy. Measurement is not absolute, but is only accurate to a certain point.

Verification
Inherent link — verification is being able to measure for yourself, to double check and save being "ripped off."

Worth — Practical
Inherent link — measurement can demonstrate a practical application of math's, and shows that math's has practical value.

PROBABILITY

Logic:
Inherent link — give gradations in examples of probability such as one in ten, one in fifty, one in a hundred, one in four million, and mention the probability of winning something like Tatts Lotto.
Indirect link — As an example of probability, there are too many factors and combinations of factors to make evolution probable.

Perceptiveness:
Inherent link — independent events do not necessarily affect each other. Superstitious people believe events are connected when they really are not. Psychological and supernatural factors can alter this relationship.

Personal responsibility:
Inherent link — probability says there is only likelihood, not a certainty. An example is death by cancer. Probability does not control or determine actual outcomes. It concerns groups not individuals. The larger the group, the more likelihood of the laws of probability operating. People get a false sense of security with probability. An example is when they consider car accidents or death by lung cancer.

Personal responsibility:
Indirect link — emphasize that life is not random, so personal responsibility is needed to make the world better.

Progressiveness:
Indirect link — it is possible to escape from probability. An example of an escape is some person who has made a socioeconomic escape through personal development to escape probability.

Stewardship:
Inherent link — explain why gambling is not productive — there is a gap between initiative and mathematical probability. There is need for careful spending on insurance which is based on probability. For example a non-drinker, non-smoker has cheaper insurance in companies such as ANSVAR. House insurance premiums are determined by location according to crime areas.

Wise choice:
Indirect link — wise choice affects the outcome, whether this is mathematical or related to life. With salvation there are two outcomes — saved or not saved. Emphasize that by choice you can increase the probability of something happening.

PROBLEM SOLVING ABILITY

The skill of problem solving is related to many mathematical values. Examples include the following:

Acceptance of value tension:
Inherent link — when solving problems, we have to keep in mind competing values. Examples are speed of operation versus task completion.

Anticipation:
Inherent link — to find minimum and maximum values when solving some problems, foresight is required. Anticipation pays dividends.

Awareness of parameters:
Inherent link — problem solutions often fall into certain parameters (for example time and cost). All the parameters have to be kept in mind constantly.
Indirect link — when making decisions in life, it is also necessary to juggle parameters.

Care in technique:
Inherent link — when solving problems, the technique is often as important as the answer. It can be important to carefully record the way we solve problems for future reference.

Careful problem formulation:
Inherent link — problems in mathematics often occur simply because of the way the examples are formulated.
Indirect link — the same holds for life's problems. The way we state or see something can itself be the problem.

Creativity:
Inherent link — we use different approaches to solve problems. We develop different "proofs" for mathematical theorems.

Order:
Inherent link — algorithms have a basis in order.

SEQUENCE AND SERIES

Acceptance of Paradox:
Indirect link — there are paradoxes in design. So in life apparent contradictions can be working together in a large scheme.

Aesthetic Appeal :
Inherent link — golden ratios are pleasing to the eye.

Dependability:
Inherent link — the value of dependability is shown in a sequence.

Economy of Design:
Indirect link — Fibonacci Series occurs often in nature eg. 1, 1, 2, 3, 5, 8 etc, suggesting an intelligent source for number patterns:
Found in pine cones, sunflower, pineapples.
It also indicates one source and mind rather than mere matter.
Relates to Pascal's triangle, again reinforces the same thread of there being a pattern or design. This indicates economy of design.

Flexibility:
Inherent link — in sequences certain steps need not be reversed, while others must be able to be reversed. For example, the statement "if and only if" is one that is true as it reads, and also in reverse.
Indirect link — In life, some things are reversible, but some are not. We need to know the difference.

Order:
Inherent link — sequences and series are orderly. Mathematics is a system that reflects order. Mathematical modeling works on the assumption that nature is orderly.

Predictability:
Inherent link — predictability comes from working out formulae from patterns. This process relates to making intelligent choices.
Indirect link — predictability can be a support for design and a designer.

TRIGONOMETRY

Awe:
Indirect link — Awe is a sense of wonder through a look at the infinite. We can use tan graphs to help achieve awe.

Care:
Inherent link — care is diligence in assessing, interpreting and analysing the information given to start with.

Choice:
Inherent link — choice is selecting the correct ratio in the process of obtaining a correct result.

Courage:
Indirect link — courage means willingness to experiment, to make a start even if you cannot see the end from the beginning.

Disposition to search:
Inherent link — there is no end to knowledge. For example, after angle sum and pythagoras, there is still more.

Investigation:
Inherent links — investigation is discovering real-life uses of trigonometry. Examples are navigation, astronomy, and surveying.

Logic and Order:
Inherent link — logic and order refer to making sure that statements follow the correct pattern, and that they are true.

Pattern:
Inherent link — pattern shows us how the trigonometry graphs in life vary in occurrence (light, sound, heartbeat, pulse rate etc).

4.5 attitudes TO CLASSWORK

Listed below are some classroom attitudes necessary for students to develop if they are to grow in their mathematical ability and ability to cope with life. Each attitude is stated in the context of what teachers may do to encourage its development.

Courage:

- Encourage students to face mistakes, to give answers in front of class when unsure, to ask questions or ask for help, to persistence, and to have the courage to question teacher or book answers.

Enjoyment:

- Foster enjoyment through success. The teacher's approach should ensure that success happens so enjoyment follows. Provide a pleasantly decorated room.

Honesty:

- Educate students to use answers wisely as learning experiences.
- Ensure students refrain from copying from others.

Learn from mistakes:

- Help students realise that all people make mistakes, including text book writers, and that mistakes show students' weaknesses and strengths in topics.
- For brighter students, point out that mistakes show carelessness. Text corrections are very important.

Mutual cooperation:

- Arrange activities so more able students can help others.
- Provide opportunities to show cooperation in student-teacher relationships.

Neatness:

- In the course of teaching, emphasise attention to detail, taking time with diagrams, clearly defining answers, accuracy in use of symbols and signs, no liquid paper, crossing out with a single line.

Organisation:

- Ensure students learn organisation in their arrangement of folders, notes, tests, corrections, and use of time.
- Discourage wasting time with undue embellishments such as changing colours in assignments.

Respect for self and others:

- Keep emphasising that every one has ability and is able to contribute in some way, and can be considered useful.
- Insist on tolerance for those who differ in race, religion, ability, beliefs, ideas, and ways of doing things. Do not allow students to laugh at the mistakes of others.
- Disapprove of derogatory statements about lower mathematics levels and those of lower ability.

Self-confidence:

- To build confidence, have students experience success at the beginning of unit in particular.
- Emphasize that making a mistake does not mean failure.
- Attempt problem solving in varying circumstances.
- Attitude of teachers to students must be positive. Avoid put downs.
- Lower ability students can achieve in certain areas. Provide opportunities for them to do so. An example of a good topic is tessellation's.

Self-discipline:

- Encourage students to do homework because of personal benefits, doing as much as they can rather than as little as they can. Show the wise use of answers, and benefits of making personal sacrifices, and patience. Emphasize patience, particularly if success is delayed.

Sense of justice:

- To develop a sense of justice, fairness must be seen in discipline and marking;
- Teachers need to admit a mistake and apologise if necessary.

Time:

- Emphasize efficiency of time, and quality of time. There needs to be short periods of concentrated effort, and undisturbed time.
- Return tests and assignments in reasonable time
- Allow planned study and revision time.
- Be an example of punctuality, showing the need to be on time
- Ensure students hand in assignments on time.
- Finish class on time.

Trustworthiness:

- There is value in teacher expectations being met. For example give enough responsibility for students to work well when left alone. Students can mark their own work at times. Homework should be done for the benefits gained, rather than through fear of detention.

4.6 assessment OF VALUES

Assessment is the measurement of students' performance in relation to the outcomes of their courses.

Assessment can take many forms. Informal assessment is carried out through questioning and observing individual students as they work, while examinations and tests are examples of more formal means of assessment.

The assessment should assess a range of outcomes which include knowledge, attitudes and skills, and not just recall. A range of assessment methods is needed to assess this range of learning abilities.

Assessment may be carried out for one or more of the following reasons:

- To find what existing knowledge or prior experience students bring to the learning task;
- To monitor the progress of students;
- To provide motivation;
- To provide feedback to students;
- To measure the extent to which students meet the course objectives;
- To establish a single global mark;
- To assess students' potential in the subject;
- To provide feedback to the teacher.

Assessing Values and Attitudes

Assessment should take account of the learning of values and attitudes. Values are estimates of worth placed on some aspect of experience. Attitudes can be seen as values revealed in action in the longer-term. They may be dispositions to behave in certain ways because of values held, or a group of a person's beliefs organised around situations, people or objects, and held over time. The assessment of values and attitudes can be difficult to put marks to, but certain kinds of such assessment can be done.

Values

- Have students identify values or recall values taught. Assessment of awareness of values can occur in tests and assignments. Seven categories of values are mentioned in this framework.
- Have students make value judgments or choices about mathematical procedures. These judgments and choices can be assessed on the quality and types of evidence or criteria used.
- Have students make their own links between mathematical concepts and life experience, whether this experience is purely intellectual or more spiritual. The criterion of creativity could be applied to this process.

Attitudes

Students need to be aware of desirable attitudes about mathematics, and know why these are important. It is important to look for changes in attitudes over time.

Assessment of attitudes can be based on observation of students in the longer-term, not just on isolated incidents. Observation can be done by:

- Teacher assessment and recording of comments.
- Self-assessment. Here students assess themselves. Students can be surprisingly honest and perceptive about their own attitudes.
- Questionnaires. Student attitudes can be assessed by completion of questionnaires.

Reporting on attitudes and values

Marks: The valuing process and attitudes could be given a weighting when compiling the overall course mark (for example ten percent or less). This could be part of test marks or continuous assessment.
Profiles: A listing of desired values and attitudes could be made and then either:
Indicate on a check list those which are observed (based on reflection or impressions over the term, or accumulated in check lists);
Or report only those observed (based on reflection or impressions over the term, or accumulated check lists). In this way teachers can build a description of a set of values and attitudes students hold about mathematics and learning.
Rating scales. Use a four or five point rating scale.
Descriptive statements. Assessments can be referred to when completing reports or testimonials which describe students' attitudes more subjectively.

Expectations and results

It is clear that students achieve better when learning expectations are spelled out clearly and regularly, when assignments are well structured, and when assessment results are provided promptly. This fact is particularly important in relation to the valuing part of learning.

Evaluation

Evaluation extends beyond assessment of how well students are reaching objectives. It goes further in attempting to judge the merit of the course and its objectives, and it seeks ways to constantly improve instruction. Therefore some evaluation could be informal. Teachers may for example observe classroom signs of teaching success, interview students informally about the course, or ask them to evaluate the course in a written questionnaire. Good teachers enjoy their success, but keep a critical eye on their own performance.

Overall, evaluation requires teachers to critically think about how achievable their objectives are, how these objectives reflect school philosophy, how well students are mastering skills and concepts, and about the appropriateness of their assessment procedures.

SECTION 5

Appendices

5.1 What Are Values?

Values are core beliefs or desires that guide or motivate attitudes and actions. They also define the things we value and prize the most, and, therefore, provide the basis for ranking the things we want in a way that elevates some values over others. Thus, they determine how we will behave in certain situations.

Values can be classified under a number of headings such as aesthetic, application to life, creativity, emotional, intellectual, social, spiritual. Examples of each are given in Section 4.1 previously.

Values can also be classified as nonethical or ethical.

Nonethical Values

Much of what we value is concerned with things we like, desire, or find personally important. Wealth, status, happiness, fulfillment, pleasure, personal freedom, being liked and being respected fall into this category. They are called nonethical values since they are not concerned with how a moral person should behave, for they are ethically neutral.

Ethical Values

Values become ethical when they directly relate to beliefs concerning what is right and wrong (as opposed to what is correct, effective or desirable). Ethical values are established by moral duties or moral virtues. Moral duties, such as honesty, fairness and accountability, oblige people to act in certain ways according to their moral principles. Moral virtues go beyond moral duties. They refer to moral excellence, characteristics or conduct (for virtues include characteristics such as charity, temperance, humbleness and compassion.

5.2 A Christian Approach to Values

Christian Worldview

There has been a trend amongst educators recently for programs to be ethically neutral and not favour any particular religious or philosophical point of view. The outcome has been that students, regardless of their social, racial, and economic background, have absorbed the unmistakable message that right and wrong are relative, that there are no core ethical moral precepts, that they must not be judgmental, that what is right for one person maybe wrong for another. Thus right and wrong are regarded as personal values, never universal or absolute and always dependent upon time, place and circumstance.

A christian world view, however,

- Accepts the values position that such precepts as stealing, cheating and lying, for example, are wrong
- Assumes the biblical principal that people are innately sinful and, when left entirely to their own devices, do not always choose the rational and good
- Assumes the existence of a certain set of core value principles that are based on Christian teachings as are expressed in the Bible

- Uses the core set of values in order to examine particular situations and choose behaviour accordingly
- Adopts the principle that values, whether nonethical or ethical, only have ultimate meaning in a biblical perspective
- Emphasises the principle and ethical values because it focuses on God as the source of reality, which included perspective

Values are derived from the worldview that sees some form of quality as being the primary reality of human existence. Values are estimates of worth or quality in some aspect of human experience. These qualities include moral goodness and all other aspects of goodness and quality believed in by the ancient civilisations before that later Greeks.

5.3 A Christian Approach to Teaching Mathematics

A Marriage of Mathematical and Christian Worldviews

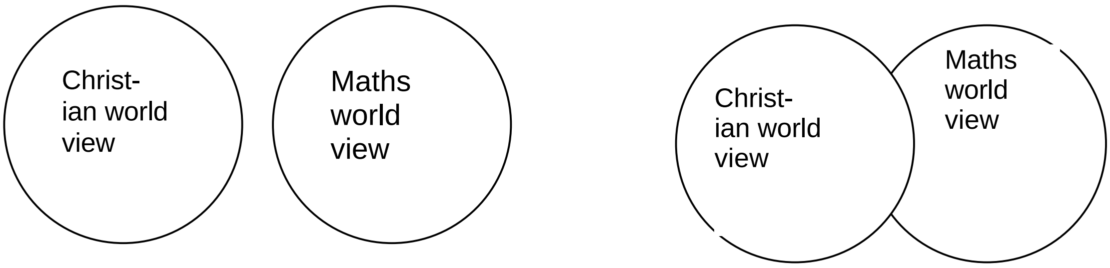
A worldview can be described as "a framework or set of fundamental beliefs through which we view the world and our calling and future in it" (Olthius, 1985)

The traditional mathematical worldview sees reason as being the chief source of our beliefs. Probability is not enough basis for belief, so the deductive method or reasoning is adopted. The starting point of reason is certain, so all that follows should also be certain.

Christians see nothing wrong with the use of reason in mathematics or anywhere else. However they do have a problem with the notion of "reason alone" as the sole source and justification of their beliefs.

The Christian worldview is based on an appeal to authority. Through faith it sees God as the source of everything. His knowledge is communicated in the Scriptures that are certain and wholly true. The goodness of God is important in this view because this guarantees he will not intentionally mislead people. By contrast human knowledge is probable and fallible because such knowledge is biased. Therefore Christians would rather surrender their belief in 1 + 1 = 2 than belief in God and his love.

The task of the Christian teacher is to integrate these two views, as is illustrated by the venn diagram below.



Bibliography: James Olthuis, On World Views, Christian Scholars Review, xiv, 2, 1985, p.155.

The Debate About Reality — An Historical Sketch

Worldviews attempt to state what is real. Ancient worldviews such as those of the Hebrews, the early Greeks and many Eastern nations accepted that the idea of “God” or some form of “goodness was the great reality of life. These words in the ancient languages also had the same linguistic roots as other words such as “oneness,” “virtue,” “excellence” and “quality”. These ideas were seen to best reflect what was real, and generated the *mythos* — the collection of stories that comprised human cultures.

The later Greeks attacked this worldview in two ways. In their search for a “universal principle” as an expression of oneness in nature, the cosmologists ended up splitting the oneness of “God” and “goodness” into two parts — form and substance, subjects and objects, mind and matter etc. This paved the way for a later debate about whether truth was more important than goodness. In this debate Plato and Aristotle relegated the idea of goodness to being less important than truth as the best pathway to find reality.

The ongoing debate about truth being more important than goodness has set up a potential conflict between the worldviews of mathematics and Christianity. This framework wishes to resolve this conflict, believing that mathematics is more than reason because it reveals some of the “quality” found in God. The truth that mathematics seeks is not necessarily opposed to this quality, but is rather part of it.