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THE LANGUAGE OF MATHEMATICS: A BIBLICAL PERSPECTIVE

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INTRODUCTION

Galileo said "Nature's great book is written in mathematical language" (Gaebelein, 1968 p60). This may not be obvious to the reader until parallels are made between the language of Mathematics and God's attributes as reflected in nature.

The writer will use this language in integrating faith and learning in the teaching of mathematics. What is the language of mathematics? What is faith? What is learning? How do faith and learning take place in the language of mathematics? What concepts of God should the teacher of mathematics have in mind as he teaches? What christian values should be brought out in the teaching of mathematics?

This essay will consists of three main sections:

- Understanding the language of mathematics in relation to faith and learning from a mathematical and biblical perspective.
- Components of the language of mathematics and their reflections of God's attributes in natures' design.
- Christian values in mathematics

Purpose of the essay.

The purpose of this essay is to show that the language of mathematics may be used to bring out attributes of God as revealed nature. Some of these attributes which will be discussed are: order, precision dependability and faithfulness, beauty, infinity and perfection. In this way, the language of mathematics helps us understand nature, and thus make us appreciate God's love for us. Teachers of mathematics should use this language to bring their students closer to their Creator.

I. THE LANGUAGE OF MATHEMATICS IN RELATION TO FAITH AND LEARNING

To help the reader understand the discussion, the writer wishes to define three terms, namely ; the language of mathematics, faith and, learning.

The language of mathematics

The language of mathematics can be defined as 'a unique universal language which transcends social, cultural and linguistic barriers, having symbols and syntax that are accepted the world over' (Orton and Wain, 1994 p.17). This language is not acquired naturally but needs systematic learning. The symbols and syntax can be universally interpreted. For example, let us look at a few symbols and what they mean:

= means equal to
< or > means greater than or less than, respectively

+ means addition

Since a language is a means of communication, mathematics has increasingly become an important means of communicating mathematical ideas.

The language of mathematics is used for communication by the media in their graphical representation of information and in their use of tables. This means of communication has been known to be concise and powerful because of the use of symbolism (Mutunga and Breakell, 1987).

We further see that in this concise language, terms are carefully and unambiguously defined and used with care. These are terms such as root, base, real, opposite, similar, square, acute, etc (Orton and Gibbs, 1994). Kline (1962) defines the language of mathematics as "a particular kind of logical structure, a body of knowledge about number and space, a series of methods for deriving conclusions, the essence of our knowledge of the physical world, or merely an amusing intellectual activity".

To illustrate the importance of this language of mathematics in understanding mathematical problems, Tabakamulamu (1998) conducted a study in some selected schools in Zambia on children's reading difficulties in mathematics, among sixth graders. These children were found to have difficulties in understanding mathematical operations because of not being familiar with the mathematical language used.

Faith

Hebrews 11:1,3 says "Faith is being sure of what we hope for and certain of what we do not see. By faith we understand that the Universe was formed at God's command, so that what is seen was not made of what was visible."

Hill (1998) defines faith as 'a life direction or orientation which may include belief and trust in God, a knowledge of God's will, an experience of God's presence ----- in one's life."

Rasi (1998) defines faith as "both a gift of God and human response to the trustworthiness of God. It is an experience that relates to our entire life - world view, beliefs, values, life styles and behaviour."

Therefore, faith is an essence of life that we learn through the whole integration process that comprises learning.

Learning

Learning is the process by which knowledge is acquired. Hill (1998) defines learning as "making connections, seeing patterns and wholeness, seeing the bigger picture, finding meaning. It is weaving things together - intergrating them."

According to Rasi (1998) the integration of faith and learning is "a deliberate and systematic process of approaching the entire educational enterprises from a biblical perspective." In this case the integration of faith and learning in the language of mathematics is a systematic way of approaching the subject from a biblical perspective.

II. COMPONENTS OF THE LANGUAGE OF MATHEMATICS AND THEIR REFLECTION OF GOD'S ATTRIBUTES IN NATURE'S DESIGN

This section will first outline some of the mathematics objectives in relation to concepts of God, before discussing the use of the language of mathematics in bringing out God's attributes in nature's design.

Mathematics Objectives

Some of the mathematics objectives the teachers of mathematics should try to achieve in the teaching of mathematics are:

- to prepare an individual student for life in general, regardless of his personal function in society, and his possible view of life.
- to prepare an individual student for subsequent education in the subject itself and other subjects, both at school and afterwards.
- to acquaint the student with the part played by language in definition and reasoning and to encourage him in the use of clear and precise language.
- to develop a constructively critical attitude towards one's own thinking so as to focus on the logic of a sequence of thought.

(Ministry of Education, 1990).

These objectives aim at improving the human society as a whole.

Concepts of God

There are also some concepts that the teachers of mathematics should keep in mind and clearly bring into the mathematics lessons as they strive to achieve the mathematics objectives. These are:-

- God is the creator of the Universe. What He created was good, but sin has distorted it all. Genesis 1:31 tells us that, "God saw all that He had made and it was very good....."

- God is a God of order, perfection, infinity and beauty. The precise language of mathematics reflects that orderliness and perfection before the fall of man.

- God's faithfulness and dependability are illustrated in the constancy of mathematical rules.

- The pattern of mathematical logic may also be used in making moral decisions. Mathematical logic makes the students question what is not clear, for to them, the answer is either right or wrong.

- Understanding a problem is half way to solving it.

One way of bringing out these concepts of God is by looking at the use of the language of mathematics in identifying God as the Great Mathematician as revealed in His attributes in nature.

God's attributes in nature reflected in the language of mathematics

Order

In every branch of mathematics, there is a logic structure. It begins with certain concepts. for example, the real number system begins with whole numbers and ends with irrational numbers. In this system, the order of numbers is progressive. It would be illogical and disorderly to have negative numbers placed after whole numbers since negative numbers are an extension of number line. These concepts must obey explicitly stated axioms. Some of these axioms of the mathematics of number are the associative, commutative, and distributive properties and the axioms of inequalities. Another example of order in number is the Cartesian product which is represented by ordered pairs (see fig. 1).

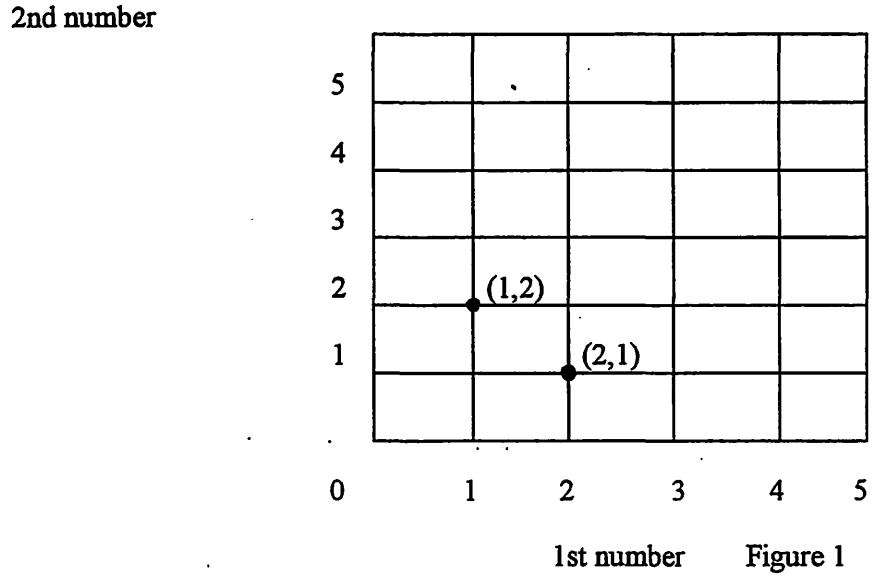

Figure 1

In this diagram the pairs of numbers follow a specific order and they are called ordered pairs. For instance (1,2) is not the same as (2,1). This kind of order can be seen in nature, for example, the seasons of the year follow a particular order which is consistent. In creation, God followed order as recorded in Genesis Chapter One and this shows that God is a God of Order and His Universe is orderly. I Corinthians 14:33 "For God is not a God of disorder but of peace."

Precision

The mathematical set language can be used to describe a great variety of different mathematical ideas and convey them with clarity and precision. In many mathematical situations, "we are concerned with a well defined universal set and a specified law or laws of combinations" (Kline, 1962). For example, in the addition of fractions, the only way to get the right answer is to use laws of combinations which allow us to look at equivalent classes of the same kind being added.

i.e. $^{5}/_{8} + {}^{3}/_{8} + {}^{1}/_{40}$

$^{25}/_{40} + {}^{24}/_{40} + {}^{1}/_{40}$

$^{50}/_{40} = {}^{5}/_{4} = 1{}^{1}/_{4}$

These laws of combinations bring about clarity and precision. In nature, we are always amazed at the precision of the sun, moon and the galaxies. In their orbit they follow the same paths at particular times each day of the year. Job also

declares that the elements follow a mathematical order. Job 38:22. Gaebelein (1968) was right when he said, "The World of Mathematical precision is God's World and it is His in a unique way." (p61).

Beauty

The language of mathematics is aesthetic and cultural in nature. The writer will discuss each of these components of mathematical beauty.

Aesthetic

The language of mathematics develops student's skills in pattern and symmetry so that they identify and appreciate the patterns around them. For example, Pascal's triangle, which is symmetrical, brings out the beauty in combinations and number patterns in mathematics where the entries are the values of nCr for nEW and rEW. It can also be expressed as an array of numbers, in which the individual numbers of the array are the binomial coefficients $\binom{n}{k}$ which can be arranged in the form of Pascal's triangle (see fig. 2).

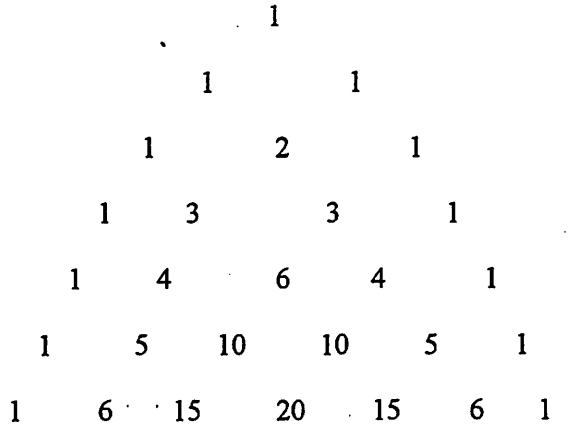

Figure 2. Pascal's triangle

The array has the following properties

- Each number is the sum of the two numbers standing above it to the left and right

  e.g. 10 = 4 + 6

- Each number is equal to the sum of all numbers in the left or right diagonal,

  beginning with the number immediately above to the left or right, and proceeding upwards; e.g. 15 = 5+4+3+2+1 and 15 = 10+4+1.

- Each diagonal is an arithmetic sequence; e.g.

  1st diagonal: 1,1,1,1,1..... Arithmetic sequence of zero order.

  2nd diagonal: 1,2,3,4,5..... Arithmetic sequence of 1st order.

  3rd diagonal: 1,3,6,10,15... Arithmetic sequence of 2nd order

  4th diagonal: 1,4,10,20..... Arithmetic sequence of 3rd order ((Newman, 1974)

The Fibonacci series 1,1,2,3,5,8,13,21,34,55..... is another example of pattern and beauty in mathematics, in which the next term in the series is the sum of the two proceeding terms; e.g. 1 1 2 3 5 8 13------

1+1 1+2 2+3 3+5 5+8

This series has interested mathematicians for centuries, in areas like the relationship between nature and the Fibonacci series. Leonard de Pisa a mathematician in 13th century, used these series in studying the birth patterns of rabbits (Courant, Robbins, 1941).

The pattern and beauty in the language of mathematics shown in Pascal's triangle and the Fibonacci series should make us aware that nothing happens by chance. God being a God of order and beauty, and the Great Mathematician, used pattern and sequence in nature. This can be seen in the symmetry of leaves and seeds such as pawpaw leaves and pumpkin seeds. God also used spiral designs in his creation to bring out the beauty in the symmetrical shape. This can be seen in the unfolding of a rose bud, horns of an antelope or of wild sheep and the spines of a pine cone, just to mention a few. Thus we can see that nature itself is made of patterns and symmetry and as we identify these patterns, we develop an appreciation for beauty in God's creation. This makes us realise that being created in God's image, we inherited God's artistic tendencies which should produce positive pleasure and a sense of self-worth in us as we identify ourselves as part of His creation.

Cultural

Each person is endowed with a natural mathematical instinct which is cultivated or moulded by the culture of that person. All societies exhibit mathematical activity in some form and Bishop (1988) classified this under six headings namely: counting, locating, measuring, designing, playing and explaining. These activities may differ in form from one society to another, but they manifest themselves in ordinary everyday tasks such as building of huts in villages. Wain in Orton and Wain (1994) describes the language of mathematics which is locked in such a culture and which is used to accomplish many ordinary everyday tasks as 'ethno-mathematics.' The Egyptians used this language to facilitate civilization in their culture, for example in the building of pyramids. As the students make mathematical models, they should be encouraged to

look for this architectural beauty. When God put a garden in Eden for Adam and Eve to tend and live in as recorded in Gen. 2: 8, He showed that He was the original architect. Hence, God is the Greatest Mathematician ever. As Gaebelein (1968; p63) put it, "Mathematics is inside the pattern of Truth."

Dependability and Faithfulness

The Language of mathematics motivates the acquisition of skills and facilitates the use of those skills. This can be illustrated in a very simple diagram (see fig 3). these skills will be used in a student's life.

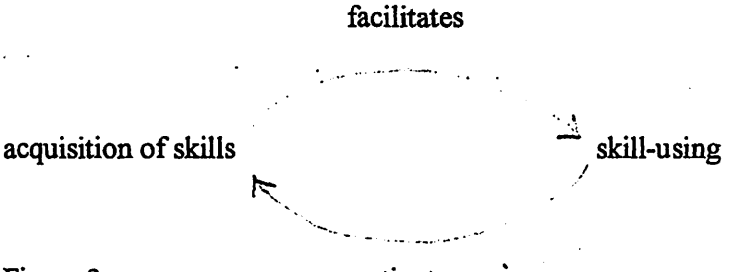

Figure 3.

Wain in Orton (1966) refers to this language of mathematics which motivates the acquisition of skills and facilitates the use of those skills as survival mathematics which is required to make sense of normal everyday situations, like the normal activities of a society. For example, in order for one to get by in an industrialised society, one will need such skills as the ability to recognise numbers in a variety of contexts, to tell time and read timetables, to understand and be able to work with measures of weight, length, area, volume, etc. These skills enable a person to carry out basic tasks of living, including being aware of time, being able to cook, to travel, to make sense of instructions to use computers, cookers, etc and even to communicate ideas that need to be put in a simple mathematical form. This dependency is also reflected in mathematical problem solving where we depend on steps like Polya's four step process when solving a problem. These are: understanding the problem, devising a plan, carrying out the plan and then looking back. These steps are reliable and can be depended upon to give a solution. This dependency in both cases should make one realise how much more one depends on a faithful God to provide the constant basic needs like air, sunshine, rain etc for one to survive.

As William M. Runyan put it:

Great is Thy Faithfulness, O God my Father

There is no shadow of turning with Thee,

Thou changest not, Thy compassions, they fail not;

As Thou has been Thou forever wilt be. (Smith, 1946)

Infinity

There is no end to the sequence of integer..... , -2-1,0,1,2,3.....,n,....for after the integer n we may write the integer n+1 and so on. This illustrates the infinity of integers. This sequence represents the simplest and most natural example of mathematical infinity. Other examples include the set of all points on a line, or the set of all triangles in a place (Marjoram, 1994). The step by step procedure of passing from n to n+1 which generates the infinite sequence of integers also forms the basis of the most fundamental patterns of mathematical reasoning which is the principle of mathematical induction. Mathematical induction is used to establish the truth of a mathematical theorem for an infinite sequence of cases. This inductive reasoning sharpens the mind and helps us understand and accept the infinite God as a God of Love. ".....The Lord's unfailing love surrounds the man who trusts in Him." Psalms 32:10.

Perfection

"The youth should be taught to aim at the development of all their faculties" Education, p232. Since the language of mathematics is precise and orderly, it develops in the students orderliness and the good quality of work. When perfection is attained in mathematics, the highest degree of proficiency is reached. This perfection was there in the garden of Eden before the fall of man. The decay in nature should remind one that perfection will only be reached by humans when sin is finally eradicated here on earth.

III. VALUES IN MATHEMATICS

Hill (1990) lists values in the teaching of mathematics, some of which are: order, pattern, self worth, dependability, accuracy, aesthetic appeal, appreciation, disciplined mind, following instructions, logic, inquiry and responsibility. In this paper's discussion on the components of mathematics and attributes of God in nature these are brought out. As the teacher teaches mathematics, these values are instilled in the students' minds. According to Orton in Orton and Wain (1994) Mathematics trains the mind and it provides deeper appreciation of life. Wain quoted Isaac Watts as saying, "If we pursue mathematical speculations, they will inure us to attend closely to any subject, to seek ideas and gain clear ideas, to distinguish truth from falsehood, to judge justly, and to argue strongly." Therefore, we can say that all the values listed above can be cultivated in the language of mathematics. "Youthful talent, well organised and well trained, is needed in our churches" (Christian Service 930).

The awareness of God's presence in nature will instill in the students a sense of responsibility in the management of God's possessions.. As Ellen White says, "True beauty will be secured, not in marring God's work, but in coming into harmony with the laws of Him who created all things, and who finds pleasure in their beauty and perfection" (Education, p198).

One way of understanding God is by studying His creation, which reveals His attributes. This can best be achieved by letting the students, under the guidance of the teacher, discover these attributes through the language of mathematics. This will arouse their curiosity and they will want to learn more. The teacher should teach so that the students will realise that "education must be an act of love, of worship, of stewardship and a whole hearted response to God". "A scholar's love of truth becomes an expression of love for God" (Holmes pp, 48, 49).

CONCLUSION

The language of mathematics can be used to bring out attributes of God in nature. These attributes reveal his supremacy. God, the Great Mathematician, reveals Himself in nature.

This study of the language of mathematics points to the changelessness of God and reveals His wisdom.

Alexander Polykov in Dembski (1998) said, "we know that nature is described by the best of all possible mathematics because God created it".

Learning mathematical processes axioms and laws can help students to more clearly identify God's design and hand work in nature. These show Him to be a God of system, order and perfection who can be depended upon. His logic is certain. By thinking in mathematical terms, we are actually thinking God's thought after Him (Hill, 1990).

DISCUSSION QUESTIONS

1. What are the consequences of disorderliness in nature's operations?
2. What practical lessons in character development can be learned from the language of mathematics?
3. How can the language of mathematics develop the mind and teach self worth?
4. What can perfection at various stages of mathematics teach us about God's dependability?

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