Institute for Christian Teaching
Education Department of Seventh-day Adventists

SPIRITUAL VALUES IN MATHEMATICS

A Procedural approach to the integration of faith and mathematics teaching for teacher trainees.

By
Hudson E. Kibuuka
Department of Education
Uganda Union of Seventh-day Adventists
Kampala, Uganda

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Introduction

Mathematics is the language of all sciences. The South Pacific Division (SPD) Mathematics Framework defines mathematics as "a powerful, precise and concise means of communication, used to represent, interpret, explain and predict." (SPD, 1989, p.5) It is also quite often referred to as the foundation of all sciences. Language is a very important aspect in human existence, just as a foundation is very important for anything which is expected to grow or last. Galileo is quoted in the SPD Mathematics Framework (SPD, 1989, p.23), as having said that "mathematics is the language that God used to create the universe." This statement stressed the foundational as well as the language aspect of mathematics.

Mann, in his paper entitled "Meditations on mathematics from a Christian perspective" (Mann, 1983, p.6) also points to the subject being very essential to man's welfare in the statement that " ... in advanced societies, mathematics makes substantial and useful contibutions to human welfare."

In almost all education systems all over the world, mathematics is stressed as an important subject. For example, in Uganda, at the secondary level, it is a requirement that mathematics be taught as a daily subject. It is, therefore, allotted more time on the timetable than other subjects, except English. It is, therefore, important to consider mathematics seriously, when we consider the integration of faith and learning.

The word value is used in this paper referring to its meaning when used as a noun to mean 'something of worth' including beliefs, attitudes, behaviours that an individual or group may consider important. (Rasi 1990, p.1)

The author agrees that integration of faith and learning in mathematics as a discipline is not a simple task- some people have suggested that it can be approached from the lifestyle of the teacher. The author further wishes to approach it from the procedural direction. This paper will, therefore, attempt to show an analogy between the teaching/ learning of mathematics, and the steps involved in obtaining a wholesome Christian experience. Analogies can be important methods of integration, although they may appear on the surface as if they belong to the conjunction relationship. (Rasi, 1990, Diag. 1) However, coupled with the lifestyle of the teacher, the two may help in the difficult task of integrating faith and learning in mathematics. Furthermore "analogies are important to Christians, because Jesus used them frequently", as stated by Gene Chase in his paper entitled "Complementarity as a Christian philosophy of mathematics" (Heie & Wolfe, 1987, p. 232) It is not the intention of this paper to look into mathematical content, although a few simple mathematical examples may be used to illustrate certain concepts. At the end of the paper, a few general properties of mathematics will be cited, which may be used to illustrate God's nature as understood by man and based on the scriptures.

At secondary school level, many students look at mathematics as a very difficult subject, and many of them deliberately turn a deaf ear against the subject. It is yet at this level adding to what one has learnt in the primary school, that a student forms a strong basis if he is to be a good mathematics student, and is to make a carrier out of it. In the study of mathematics, or in becoming a mathematician, there are certain essential steps which a student has to follow before being able to achieve his objective. This paper will now attempt to outline them below.

I. ATTITUDE

The student's attitude towards a subject is very important. Reading in the Bible in the book of John, chapter six, Jesus had fed the five thousand men, and they had followed Him to the other side of the lake. He taught them, including His disciples, about the Bread of Life. Many of them did not understand, because they were after something different. As a result, they decided to leave Him and go away. He then turned to His disciples and asked them, in John 6:67, "Would you also like to leave?" In other words, He was saying to them that if you are willing, you may stay, but you are free to go. The choice is yours. There was no coercion.

The student of mathematics must develop an attitude of willingness to learn the subject, or else, like some of Jesus' followers, he may decide to give up. Of course, in a school, the student

may be obliged to continue attending the class, since it is a school requirement. The teacher, also, continues showing all the students the importance of studying mathematics, but if the student has decided to give up, nothing can be done to him, until he decides by himself to do otherwise. Freedom of choice is a gift God has given everyone, even when it comes to one's salvation. Through His appointed agents, God shows every individual the way to salvation, but the decision is always left to the individual. Before willingness, however, one must realize that he is helpless. This applies to the student of mathematics, just as it applies to a sinner. It is the task of the teacher to show the student what is good in mathematics, that he lacks, and which he will continue lacking, if he does not study the subject. Lifestyle plays a big role here, both in the teaching of mathematics, as in the preaching of the gospel. Mathematics teachers whose lifestyle conforms to what they teach, are as successful as a gospel worker who lives what he preaches. In mathematics, this would involve such things as being time-conscious, accurate, smart, creative andccareful in decision-making. Rasi when talking about communicating values says that values are communicated through attractive models and positive relationships (Rasi, 1990 p.4) Holmes on the other hand, has said that man is both a rational-reasoning, as well as a valuing being. (Holmes, 1989, p.29) This implies, therefore, that man is able to place value on objects as well as determining which object is more valuable than the other. This attribute of man is very much improved through the study of mathematics.

II. ACQUISITION OF KNWOLEDGE

Having realised the need and having the attitude of willingness to learn mathematics, a student then has to acquire knowledge. This includes the following, according to SPD Framework: being 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 theories and their proofs, when appropriate
6. know relevant procedures and techniques such as method of proof by induction etc.
7. recall basic shapes of the graphs of the functions and relations used
8. understand where mathematics is used in real life

(SPD, 1989, p.8)

The primary agent for the acquisition of such knowledge is the teacher, and the secondary one are the books. Once a student has decided to learn mathematics and is willing, it is his part to be attentive to what is being taught by the teacher, and to open his mind to learn. This knowledge or the subject matter comes in from outside, just as salvation comes to sinners from outside. God, through His agents, makes sure that the helpless

sinner gets the good news of salvation which he cannot recieve from within himself. Paul, in Rom. 10:17 says, that "faith comes from hearing the message, andthe message comes through preaching."

Secondly, knowledge in mathematics is acquired through reading and studying mathematics books, just like faith can also be acquired through reading and studying the Bible. This knowledge would remain artificial if it is not given a chance to settle deeper into the mind. The next stage is one through which this is achieved.

III. INTERNALIZATION

This is the stage during which what has been learnt is beginning to settle in the mind, and thus becomes a part of the learner. It is part of the process of growth in mathematics. This is done through computational skills. Mathematics cannot be learnt without a lot of exercises through computations, calculations, graphing and drawings or geometrical constructions.

> "To appreciate mathematics, one must learn the skills whether he is a king or a beggar." (Mann, 1983, p.5)
>
> "Values are also communicated through gentle reasonings, appropriate readings and guided discussion (Rasi, 1990 p.5)

Just like every growing being or system experiences growing pains and discovers some amazing features, which is also true in Christian growth, mathematical growth also offers several

challenges during this stage. Gene Chase has said, in his essay entitled "Complementarity as a Christian philisophy of mathematics", that "mathematics has both amazing power and humbling limitations." (Heie & Wolfe, 1987, p.245) Always a student of mathematics gets excited when he is successful in solving mathematical problems and yet, being able to do so requires humility, patience and diligence to obtain a solution. These are great values which the teaching learning of mathematics brings to the life of a learner.

Mathematics, further, can better be learnt if taught using the principle of from simple to complex. The student begins with the simple skills and as he develops his perception of the subject, then he becomes able to digest the harder food; the more complex skills.

It is also at this level that both group work and private daily exercise is emphasized. These are other values which are obtained through the teaching and learning of mathematics. Group work cultivates the social value in the student by being able to accept responsibility, contribute, follow directions, listen, persevere and tolerate. (SPD, 1989, p.12) Group work inculcates sharing and all of these are important spiritual values a Christian should develop. In a group, it is those who are willing to learn who benefit and, in turn, share what they learn with others.

Mr. Shavlick, a former teacher of mathematics at Bugema Adventist College, always stressed the importance of patience, endurance and diligence in the learning of mathematics, as well as in Christian experience. He always advised his stuent that for one to master his subject, one had to patiently persist, just as for one to inherit eternal life, he has to endure hardships and persist patiently.

IV. APPLICATION

Another important stage in the learning of mathematics is the stage of putting what has been learnt to use. This is the applicational approach to integration of faith and mathematics, which is referred to by Gene Chase (Heie & Wolfe, 1987, p.231). He refers to this as the argument that mathematics is useful for Christians in daily life, such as in computer-aided instruction for Christian education, or data analysis of Sunday school attendance. By so doing Gene looks at the applicational approach as referring only to mathematical application in daily life. The author wishes to expand on it from three dimensions; (A) application in other disciplines, (B) application in daily life, and (C) application in development or advancement, because practical application and personal experience is yet another way values are communicated.

A. Application in other disciplines

In the introduction of this paper, mathematics was referred to as the language or foundation of the sciences. The next stage, therefore, for a student to appreciate mathematics, is to be able to apply it in other sciences, which can not be easily learnt without substantive knowledge of mathematics.

"Many disciplines depend on mathematics as a symbolic means of communication." (SPD 1989, p.6) Mathematics, therefore, is versatile. It is applied in all other disciplines and helps to understand them, especially the sciences, although it also helps to some degree in the non-science subjects, directly or indirectly throught such things the scientific gadgets which are used in teaching, production of books etc.

B. Application in daily or real life

This is probably the area where mathematics has been used and continues to be applied directly or indirectly. Knowing the acreage of one'siland, knowing the number, sizes and ages of one's children, managing finances in farming are just a few of the very simple examples which occur in the real life of almost anyone. In construction of shelters, which is one of man's basic necessity, some geometrical shapes are observed almost everywhere, even in the ancient times. This is another value which can be and has been greatly improved through the study and application of Geometry - a branch of mathematics.

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C. Application in development

Much advancement today, be it in the family, in church or national, is based on science which employs a lot of mathematical concepts for its intepretation. In the same way as the ultimate goal of advancement for a Christian is to have hope beyond this world through faith, mathematics plays a very important role in advancement almost synonamous to that of faith. However the Bible says in James 2:26 that "faith without works is dead". In the same way, mathematics without exercise and application is not mathematics. A genuine mathematics student is usually also a good science student, although he can be good in any other discipline, and will always be interested in applying his knowledge to some real-life-experience. A true teacher of mathematics always stresses the applicability of mathematics and its relationship with other disciplines.

Wil Clarke, in a paper entitled "The finite, the infinite and God", cites Galileo as having supposed that there are equal points of contact on a circle of radius 2 inches, as on one of radius 1 inch with a common centre. (Diag. 1)

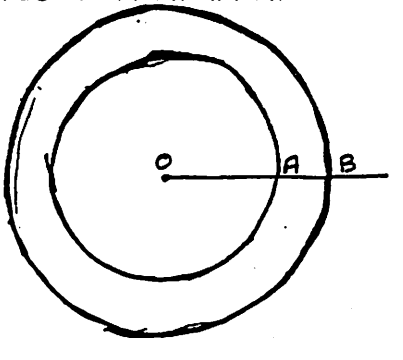

Diagram 1 (Clarke, 1988,p.4)

This Geometrical figure can be used to illustrate God's nature of love.

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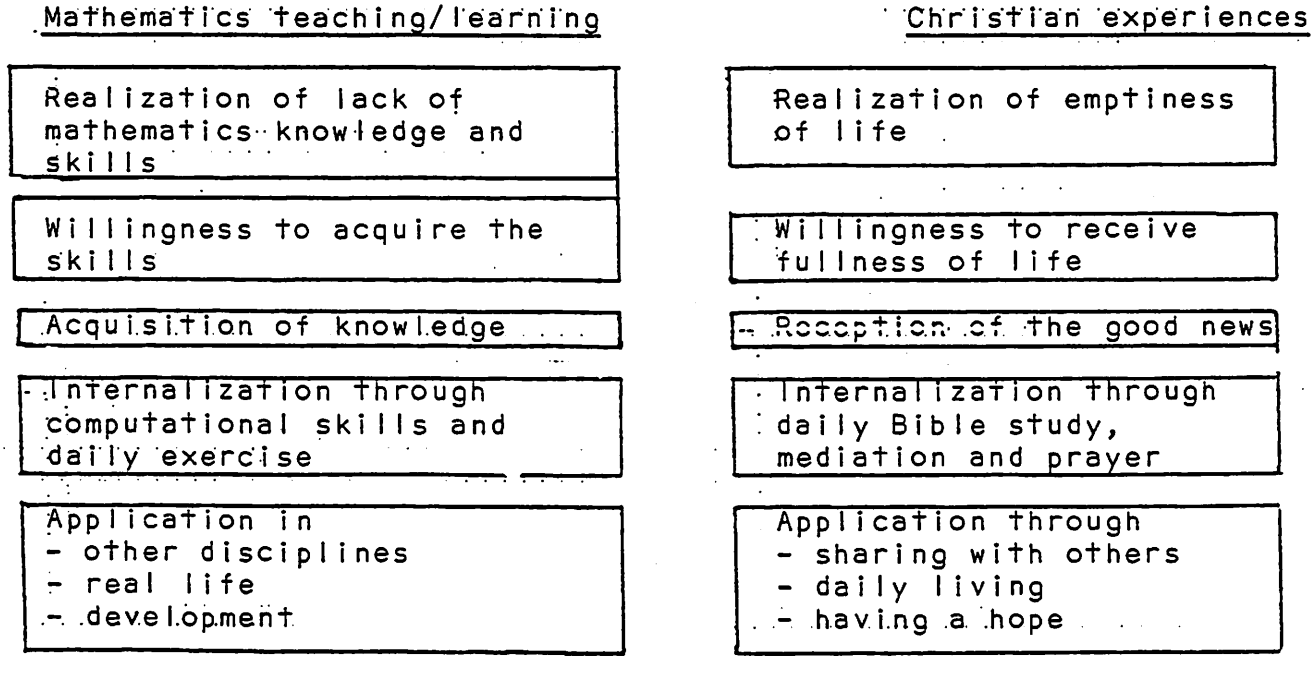
Galileo argues that for every point B on the larger circle, there exists a corresponding point A on the smaller circle where a line from the centre "O" meets the smaller circle. Putting God at the centre of the universe, there is no one with whom He has no no contact. Likewise, if He is placed at the centre of life, there is no aspect of life which He will not be able to direct. The Bible affirms this in Psalms 147:4 and Isaiah 40:26 when it says that He knows even the hairs on our head, just as He knows the name of every star.

The preceding discussion shows that the teaching and learning of mathematics has close analogy with Christian living. This analogy may be represented in a simple flow diagram.

Diagram 2



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Conclusion

In concluding this paper, the author would like to give a few examples of how mathematics teaching and properties may help to explain the nature of God and Christian experience.

The first one is based on the common belief that mathematics is a hard subject. A similar argument is used in connection with Christian living and salvation. However, Mann talks of mathematics as being both easy and difficult (Mann, 1983 p.10) It is easy in that ambiguity is minimized, and hard because using the wrong method or approach conveys the wrong meaning. Similarly, the Christian life is also easy and hard. It is easy through applying the right method of faith and yet hard because man always tries his own methods, which don't work.

The teaching of systems, symmetry, order and accuracy portray very important characteristics of God, from the way He has placed them in nature. He is a God who can be depended upon, who has placed things in their proper places, according to order. The SPD Mathematics Framework quotes Byrne in his book " A Christian approach to education" as saying that "Mathematics is a revelation of the thought life of

> God. It shows Him to be a God of system, order and accuracy. He can be depended upon. His logic is certain. By thinking in mathematical terms, therefore, we are actually thinking God's thoughts after Him." (SPD,1989,-.6)

In relating mathematical properties and Christianity, it is, however, important to be careful. Some topics in

in mathematics can not easily be related to God's character or Christian experience such as probability and logic. Mann (1988, p.7) in talking about axiomatization, which is a common tool of mathematics, says the following:

> "Axiomatization is a powerful method of producing mathematics, but great caution must be exercised by those of us who use the method when we look at other fields. Such caution is especially important when reading and applying scripture. This caution is necessary because a process similar to axiomatization is necessary for application. One must read the scriptures, recognize principles and apply the principles to new situations. The danger is that the mathematician will denigrate the scripture into a small number of principles from which he believes or else can be derived by logic. Since this is not the nature of scripture, false conclusions will result from the processes."

What the above implies is that using mathematics properties to explain scripture should be done carefully, so as not to denigrate the latter.

This paper, as was pointed out in the introduction, has dealt mainly with the procedural approach of integration rather than the content in mathematics.

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