MATHEMATICS FROM THE VIEWPOINT OF SCIENCE IN CONTEXT

Johan de Klerk
Department of Mathematics and Applied Mathematics
Potchefstroom University for CHE, Potchefstroom
South Africa

Summary

One way of an integration of mathematics and a Christian point of view is discussed in this paper and highlighted with some examples. It is not always easy to draw lines from a Christian point of view to the cold mathematical symbols. But, to reason that it is difficult and to do nothing, is not a solution to the problem. It is reasoned that it is every Christian's duty to start somewhere, however small the first attempt might be.

1. Introduction

As a Christian teacher of mathematics one is always confronted by one's calling and the problem of lecturing mathematics from a Christian perspective. Even textbooks and periodicals concerned with general science from a Christian point of view, usually do not give much attention to these matters – especially when it comes to the practical class-room situation.

These matters are of course of the utmost importance. Students have to realize that they have a calling with regards to their scientific studies. They also have to know what it means to live to the glory of God in science – and especially mathematics (Maatman, 1986:11). Usually the attention given at university or at school to the lecturing of mathematics from a Christian point of view is minimal (Van der Walt, 1990:247-257).

In this talk I would like to give attention to one way of integrating a Christian point of view and the lecturing of mathematics. This method has been applied at our university during the last few years to a certain applied mathematics course (TGW316: Partial differential equations). My intention with this is to show that it is possible to integrate a Christian point of view and mathematics, with emphasis on some practical aspects.

My point of departure is that one's whole life is religion and that there is no part of one's life that can be called "secular". Fowler (1981:6) puts it this way: "To see eating and drinking as a way of expressing our love for God, not by means of accompanying grace, but by the act of eating and drinking itself; to know how a commercial career can be as rich an experience of serving God as a career in theology; to experience a visit to the toilet as an act as holy as prayer". Such a life most certainly also includes mathematics.

In the next part of the talk I would like to give a short summary of the above-mentioned applied mathematics course. Thereafter I would like to discuss the view of

science in context (which served as background for the presentation of this course). Attention will be given to seven different contexts and to some examples which were used during the past two years. I will finish my talk with some general remarks.

2. The course TGW316: Partial differential equations

It is necessary to say something about this course. The course consists of the building and solving of different mathematical models of phenomena from physical reality. Typical problems which are usually discussed, are the vibrating membrane and string, heat flow in a bar and the potential inside and outside of a spherical capacitor. In the solution of these problems some other mathematical concepts which are needed at a certain stage, are also discussed.

Some of the more important "mathematical tools" that are used in this course, are ordinary and partial differential equations. The formulation and solution of differential equations play a very important role in the mathematical modeling of many problems – whether from mechanics, botany, economics, etc. The development of the mathematical concepts "differentiation" and "integration" (which forms the basis of this course) took place during the time of Newton and Leibniz (Kline, 1972:378-381). Historically the mathematics concerning these matters – namely calculus – has a very interesting development, so that one can easily and unforcedly put emphasis on the history and accompanying points of view of the last few centuries.

3. The view of science in context

However good a theoretical philosophical idea may be, the most difficult part is usually to apply such an idea to the daily, practical class-room situation. For a practical integration of a Christian point of view and mathematics, the viewpoint of science in context may serve as a meaningful frame of reference and starting point. Particularly in this course on differential equations the contexts around differential equations could be uncovered and account could be given of some philosophical ideas. Students could afterwards formulate their own viewpoints on the issues raised (Anon., 1992:91-93).

The point of view of science in context can be viewed visually as a point (the detail of the subject) with some circles (the contexts) surrounding it, and also with some connection lines between the circles. Some contexts – like the historical context for example – may even cut through the others. Whether one discusses all the under-mentioned contexts or whether it is discussed in the given order) is not really important. What is of importance is that this methodology gives a practical, meaningful starting point for a class-room discussion.

The science in context point of view is a wide picture of science (Geertsema, 1992:1; Stoker, 1976:135). Seen as such a wide activity, people of different points of view will view science differently, but when it comes to the detail, there will usually not be differences. This doesn't mean that science as such is neutral, because the activities are related to the contexts, and they can't be neutral.

In order to give some practical guidelines, the further discussion will be given in relation to the above-mentioned course and the following typical contexts: (a) the context of religion, (b) the context of the cosmos, (c) the context of society, (d) the

context of science, (e) the context of the history of mathematics, (f) the context of mathematical theories, concepts, etc., in a broader sense, and (g) the context of mathematical theories, concepts, etc., in a narrower sense.

3.1 The context of religion

God wants to make Himself known to man. This He does by means of his Word (in nature, by Scripture and through his incarnated Son). Our scientific knowledge, therefore, must lead to an intensification of the love between God and man. In particular, the study of partial differential equations must also lead to the glorification of God.

The physical universe which God created, is based on orderliness and creational laws. Mathematics is one way of describing some of these creational laws – and the study of partial differential equations must also show something of this orderliness.

A big danger for a mathematician or an applied mathematician is the possible absolutisation of mathematics; therefore we always have to remember that mathematics doesn't make better people of us, it only gives us a finer focus on reality. We can only find the meaning and sense of life in Jesus Christ and not in anything else. If such a meaning is looked for in mathematics, there is the very real danger of making a god of mathematics.

The previous remarks are not just an imaginary or academic danger. Some two hundred years ago the German Friedrich von Hardenberg already remarked (Davis & Hersh, 1981:110): "Pure mathematics is religion". Later (in 1925) Oskar Schlemmer put it like this (Davis & Hersh, 1981:110): "It is the ultimate, the most refined and the most delicate". The authors Davis and Hersh also ask: "Can we conclude that mathematics is a form of religion, and in fact that true religion?"

It is therefore possible to make a mathematical god (and in such a way that the true God of the Bible isn't noticed and professed any more) – and this is a subject which can be raised once or twice during a course. Let us remember that mathematics is also only part of creation and that it can't transcend creation. Realize – and thank God for that – that He created us in his own image and that he gave us the intelligence to understand something of his creation.

3.2 The context of the cosmos

Discussing the context of the cosmos in class, there are lots of matters that can be discussed. I will only mention two.

We confess that we see the orderliness and beauty of creation. A Christian mathematician (who usually looks at creation through mathematical glasses) might raise the following questions of conscience: Hasn't the physical creation only become a mathematical order? How far is nature still beautiful and interesting? Perhaps only so far as it can be counted, measured and weighed? Or only when it can be mathematized and thus be controlled mathematically? Is such a mathematisation of nature and culture not already a purpose on its own? Seeing the hanging cable of a cable car between two masts, don't we as mathematicians only see a cosh function? Is

a spleenwort leaf still some kind of fern, or has it become only a beautiful fractal picture on a computer screen? Everyone of us should be aware of these dangers.

Another question for a class (also with reference to Barrow (1992:36)) is the following: Has mathematics been created by God, or has it been designed by man? Putting it another way: Is mathematics something we discover, or do we invent is? And what about differential equations? Is there something like a "mathematical cosmos" – a kind of "mindscape" as (Rucker, 1982) put it – with the mathematical objects waiting for us to be picked up (just as the rocks on the moon had been there, even before Neill Amstrong walked on the moon).

3.3 The context of society

If there are practical applications of a subject they should be used to the well-being of one's fellow-man. In the case of partial differential equations there are many applications. Whether the applications are always to the well-being of one's fellow-man, is a different question. In building an atomic bomb or in calculating the trajectories of ballistic projectiles differential equations are certainly used. Often – hopefully most of the time – mathematics is used to the well-being of one's fellow-man.

A beautiful example for an appreciative class, and an example which one can link up with the study of the wave equation for the vibrating string, is the following: By means of the solution of the wave equation one can explain the phenomenon of fundamental modes and overtones. This phenomenon is also closely lined with the development of the tempered musical tone – a matter which was settled in the time of JS Bach, and which inspired him to compose his familiar "Das wohltemperierte Klavier".

3.4 The context of science

In the broad scientific context one should use mathematics (and therefore also partial differential equations) to unfold truth and also to support other scientific disciplines. There are authors who reason that in future mathematics (or at least the study of mathematics) wouldn't be necessary any more, because computers will do everything (Boas, 1980:172). Does this also apply to differential equations?

Concerning the context of science, another matter that can be discussed in a class, is the whole question of inductive and deductive methods. Fourier analysis is also part of this course and comprises the Fourier development of mathematical functions. Because Fourier himself was able to develop this for many functions, he was satisfied (by silently making use of an inductive reasoning) that his method had to work for every arbitrary function. Today we know that this is not the case – but it took more than a century of mathematical struggling to put the existence of Fourier analysis on a sound mathematical footing.

3.5 The context of the history of mathematics

Studying the Christian perspectives in a mathematical course, the historical context is perhaps the easiest to start with. The mathematician Poincaré, for example, said that if we are to be aware of the future of mathematics, our real route should be

the study of the history and present state of science. There is certainly no limit to the historical issues that can be discussed, and only one will be mentioned here.

The general different points of view of the past and present have also had their effect on mathematics. Therefore, the development of partial differential equations also has to be viewed against such a background. Fourier analysis, for example, originated in the era of rationalism. Due to the general point of view of the time, and also due to the development of mathematics (and the self-confidence of the mathematicians) God was moved into the background. When the Frenchman Laplace donated a copy of his work *Mécanique céleste* to Napoleon, the latter mentioned the fact that Laplace had never even mentioned the name of the Creator. To this Laplace replied – as the story goes – that he has no need for such a hypothesis (compare Davis & Hersh, 1981:68). Fourier analysis had its birth during a time in which God was of little or no importance for the natural sciences.

3.6 The context of mathematical theories, concepts, etc., in a broader sense

Mathematicians like Legendre, Laplace and Bessel (important names in this course) lived in an era in which mathematical thinking was loose and intuitive (Kline, 1972:617). By the 1850's mathematical proofs were of no importance. In a paper of 1858 Cayley (1821-1895), for example, announced what is now called the Cayley-Hamilton theorem for square matrices of any order. Cayley states that he had verified the theorem for the 3 x 3 case and that further proof – that is, for the general $n \times n$ case – was not necessary (Kline, 1972:807-808).

However, some mathematicians were fortunately dissatisfied with the bad state of affairs. In time, matters improved and there was always a search for better foundations and coherence of mathematics. But here we should also remember that the foundation of everything – that is, of mathematics and also of the physical reality which we try to model mathematically and which plays such a large part in this course – is to be found in Jesus Christ. Therefore – like all the other contexts – the meaning of life can't be found in this context (also compare Van Riessen, 1970: 165-176). Together with Chase (1981:86) we can state that "… no viewpoint will be found, even in principle, this side of heaven, that can unify all of mathematics".

3.7 The context of mathematical theories, concepts, etc., in a narrower sense

One wouldn't notice God's love and the beauty of his creation by "running" through life. One has to think about it peacefully and tranquilly. As a mathematician one is fortunate to view it from a mathematical vantage point. And this also applies to the study of partial differential equations. If one studies, for example, the string and percussion instruments of a symphony orchestra mathematically, one discovers that the mathematics describing the movement of the vibrating strings and of the vibrating membranes of the drums are actually the same – except for a dimensional difference. And think about the fact that the sound of a gong and a drum can mathematically be described by the same partial differential equations; the only difference being the boundary conditions.

4. Summary

One way of an integration of mathematics and a Christian point of view was shown and highlighted with some examples. It is certainly not always easy to draw lines from a Christian point of view to the cold mathematical symbols. But, to reason that it is difficult and to do nothing, is no excuse. Start somewhere, however small the first attempt might be.

It is certainly not necessary to discuss all these contexts during one class. Some of them can be discussed once or twice during a term, and others more often. However, what is important is to give attention to these matters on a regular basis. A good practical method is to start every lecture with a short discussion on one or more of these contexts and to proceed from there in a normal way to the formal mathematical matters.

Typically the detail of any subject in the exact sciences (like, for example, the mathematical techniques for the solution of partial differential equations) as lectured by a Christian and non-Christian wouldn't differ. The difference, however, would rather be in the different contexts which are related to the subject under discussion. And that is what I have tried to show. In this way, I believe, one can do one's scientific work in the light of God's Word and one can integrate one's Christian perspective with mathematics.

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