

Whither Mathematics Education in the 21st Century?

The futility of unbelief

The plight of man is pitiable. We are wanderers in a vast universe, helpless before the devastations of nature, dependent upon nature for food and other necessities, and uninformed about why we were born and what we should strive for. Man is alone in a cold and alien universe. He gazes upon this mysterious, rapidly changing, and endless universe and is confused, baffled, and even frightened by his own insignificance ... The life of man is solitary, poor, nasty, brutish, and short. He is the prey of contingent happenings. Endowed with a few limited senses and a brain, man began to pierce the mystery about him. By utilizing what the senses reveal immediately or what can be inferred from experiments, man adopted axioms and applied his reasoning powers. His quest was the quest for order; his goal ... to form patterns of explanation that might help him attain some mastery over his environment. His chief accomplishment, the product of man's own reason, is mathematics.¹

So pontificated the late Morris Kline twenty years ago in the concluding pages of his classic and controversial unmasking of the crippled state of mathematical foundations. Kline, by denying the comprehensive authority and applicability of God's word, especially in the area of epistemology, is left to his own meager devices; and meager they are. Assuming the autonomy of man's reason leads Dr. Kline down a thorn-filled path of uncertainty, insignificance, despair, and hopelessness. His new god, mathematics, is the only vehicle through which meaning and order can be carved out of a universe assumed to be void of the same.

It was not long ago that I read, for the pure enjoyment of it, a fascinating and almost unbelievable World War II escape epic by David Howarth entitled *We Die Alone*. Nestled within its pages was an exposé that echoed Dr. Kline's bafflement of hopelessness:

In his loneliness, he wished he was able to pray, and lying there waiting to die he tried to set his religious beliefs in order. But like so many young men of his generation, he had grown up without the habit of saying prayers. It was not any fault of his. He had been given a technical, scientific education, and there had not been much room in it for religion. It had given him, at the age of twenty-six, a materialistic view of life. He had done his best to live in accordance with Christian ethics, but nothing he had ever been taught could help him to believe in a personal God who watched over him in Revdal.²

Contrast the above with the testimony of Cornelius Van Til:

In it [Christian grade school – J.N.] I learned that my being saved from sin and my belonging to God made a difference for all that I knew or did. I saw the power of God in nature and His providence in the course of history. That gave the proper setting for my salvation, which I had in Christ. In short, the whole wide world that gradually opened up for me through my schooling was regarded as operating in its every aspect under the direction of the all-powerful and all-wise

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God whose child I was through Christ. I was to learn to think God's thoughts after him in every field of endeavor.³

The importance of a truly biblical outlook

The purpose of this essay is to articulate what I believe to be the direction for reform in mathematics education in the 21st century. The twentieth century saw many attempts at reform in the government schools. For example, in the 1950s the reform focused on "back to the basics." The agenda for the 1960s was the "New Math." That approach proved to be a dismal failure and in the 1970s we saw a return to the "basics." The 1980s focused on the "problem-solving" approach and the 1990s fad was "group learning." The mainstream of the Christian school movement was for the most part content to follow these reforms in lock step letting the "blind lead the blind." The problem with all these attempts at reform was (and is) an underlying and oftentimes unspoken assumption; i.e., the myth of epistemological neutrality. Proverbs 9:10 states, "The fear of the Lord is the beginning [substructure – J.N.] of wisdom and the knowledge of the Holy One is understanding." This means that there can be no true knowledge about anything (and that includes mathematics) unless the Lord God of Scripture is first honored and respected. All of our thinking in every realm must be done, in the words of Van Til, "on the basis of the self-authenticating revelation of God."⁴ *It is only upon this basis that the quest for mathematical knowledge has any meaning.* The current craze in government schools to "get the math scores up" pales in comparison to the biblical standard for pursuing knowledge. Where today do we hear confessions like the following made by Johannes Kepler (penned after a series of mathematical demonstrations)?

Accordingly let this do for our envoi concerning the work of God the Creator. It now remains that at last, with my eyes and hands removed from the tablet of demonstrations and lifted up towards the heavens, I should pray, devout and supplicating, to the Father of lights: O Thou Who dost by the light of nature promote in us the desire for the light of grace, that by its means Thou mayest transport us into the light of glory, I give thanks to Thee, O Lord Creator, Who hast delighted me with Thy makings and in the works of Thy hands have I exulted. Behold! now, I have completed that work of my profession, having employed as much power of mind as Thou didst give to me; to the men who are going to read those demonstrations I have made manifest the glory of Thy works, as much of its infinity as the narrows of my intellect could apprehend.⁵

Before I continue, let us face some hard facts. Culturally, those who understand a biblical Christian perspective on mathematics (and every other area of life) are on the fringe of both society and, sadly, the mainstream church. This can be discouraging, but, according to God's word, we are not to "despise the day of small things" (Zechariah 4:10). One of the mysterious and wondrous ways of God is the way of the mustard seed (Matthew 13:31-32).⁶ The biblical command to salt and light the world comes through the slow, almost imperceptible process of leavening culture one generation at a time (Matthew 5:13-16; 13:33). Let us make sure that our salt is pure sodium chloride and that our light is a floodlight

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and not some miniature flashlight. That means developing a distinctively biblical Christian mathematics curriculum; a curriculum that deliberately and conscientiously incorporates a biblical view of knowledge, understands God's providence in history, and sees science as descriptive of the wisdom of God in Christ as revealed in the patterned structures of creation. We should not be content with what I call "mathematics-lite." By that I mean the understanding and teaching of mathematics filtered through the sieve of unbelief no matter how popular and seemingly useful that sieve is.⁷ In the space that I have remaining, I would like to make three modest proposals that will I trust will turn "mathematics-lite" into "mathematics-heavy" and thereby properly reflect the glory of God.⁸

Proposal #1: Skills vs. theory in the creational context

$2 + 2 = 4$. In what context do we understand this? We have only two choices. One states that this is just the way things are (the product of time + chance + matter) and then proceeds to teach "math facts" (or math skills) in a purely mechanical and ultimately meaningless way. This perspective encourages the teaching of things merely "in the air" with no coherence or connected train of thinking. In the past century an almost uncountable number of math textbooks have been written that contain nothing but a series of disconnected topics (e.g., fractions to exponents to factoring to solution of equations to complex numbers to mathematical induction to permutations and combinatorics, to ... *ad infinitum*). Without an understanding of mathematics in the creational context, it is very easy for textbook writers to succumb to the "meaninglessness of the particular facts."⁹

The other choice states that $2 + 2 = 4$ because this is the way the triune God has structured both creation to reflect and our minds to think. From this perspective, the teaching of "math facts" is now focused upon God and His creation. The student bathed in this God-centered atmosphere will ultimately confess, "How great is the Creator who has made both the mind and nature so compatible!" The student might even want to compose a psalm of praise to God as a homework exercise! Do not be surprised. This has been done before. One of the joys of reading the works of Kepler is to find psalms of praise cropping up periodically throughout his writings. This perspective also provides a basis for a true understanding and appreciation of the unity in diversity (reflective of the triune God, the "one and the many") and the patterned order (reflective of the wisdom of God in Christ) both in creation and in the structure of mathematics. The understanding of mathematics in the creational context brings true and ultimate meaning, coherence, and connectivity to "the particular facts" of creation and mathematics.

As we approach each mathematical topic, we should ask two important questions: (1) What information does this topic give us about the quantifiable nature of the created order? (2) How does this mathematical topic connect or cohere with other mathematical topics? As we answer these questions we will resolve a thorny dilemma that often appears in mathematics instruction; the dilemma of teaching math skills vs. teaching math theory. Oftentimes, these two positions are set at war with each other. This battle originated with the classical Greek differentiation between *arithmetic* (the theory of number) and *logistica* (the practice of commercial arithmetic).¹⁰ It is mathematics as an art vs.

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mathematics as a trade (cf. electrical wiring to electromagnetic theory). The art and the trade must be combined and balanced. Too much trade teaching (the tendency of most elementary and high school textbooks) is like eating tripe while neglecting the steak. Too much art teaching (the tendency of most college textbooks) is like eating the steak without taste buds. Mathematical techniques (e.g., doing sums and products or factoring quadratic equations) can be boring and they can easily become mindless exercises. The student must be led to understand that they are the necessary details (i.e., the grammar) that must be mastered to properly understand greater issues (i.e., composing a paragraph). The *logistica* of mathematics should be taught or introduced when needed for some larger goal; a goal that the student should firmly comprehend.¹¹

Proposal #2: The abstract/concrete connection

A good definition of mathematics is that it is an *abstract* formulation of ideas suggested by the patterned structure of God's creation. It is the artful use of the God-given reasoning processes to make connections (find unity in diversity) and then to infer and deduce new facts about creation; i.e., to discover the wisdom of God in Christ hidden in creation (see Proverbs 25:2). It is a series of significant assertions about the nature of creation and its conclusions impact almost all the arts and sciences (either in the context of aesthetical beauty or dominion mandate applications).

Mathematics in abstract must be tied to its concrete foundations. Neglecting or ignoring this tie is like living on a diet of pea soup and carrot juice; it is "mathematics-lite." Connecting mathematics to the physical creation is like eating prime rib along with a glass of Chardonnay; it is "mathematics-heavy." The absolutization of abstract mathematics is form without substance; it is the shell without the kernel.¹² The concrete kernel is the physical creation. Mathematics is not ultimately an island to itself; pure, abstract mathematics in itself has nothing to say and it will say nothing to our students (except to drive them away from the subject).

Note carefully how Alfred North Whitehead describes the powerful connection between abstract mathematical concepts and the concrete:

The science of trigonometry arose from that of the relations of the angles of a right-angled triangle, to the ratios between the sides and the hypotenuse of the triangle. Then, under the influence of the newly discovered mathematical science of the analysis of functions, it broadened out into the study of the simple abstract periodic functions which these ratios exemplify. Thus trigonometry became completely abstract; and in this becoming abstract, it became useful. It illuminated the underlying analogy between sets of utterly diverse physical phenomena; and at the same time it supplied the weapons by which any one such set could have its various features analysed and related to each other [unity in diversity – J.N.]. Nothing is more impressive than the fact that as mathematics withdrew increasingly into the upper regions of abstract thought, it returned back to earth with a corresponding growth of importance for the analysis of concrete fact.... The paradox is now fully established that the utmost abstractions are the true weapons

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with which to control our thought of concrete fact.¹³

Proposal #3: The place of science and history

I can remember when I taught mathematics courses in Australia that my students would often ask me, “Mr. Nickel, I’m confused. What class are we in? Our schedule says that this is supposed to be the mathematics class, but it sure sounds like a history or science class to me!”

The content of a biblical Christian mathematics curriculum must provide motivation, sustain the interest of the student, exhibit methods of the operation peculiar to mathematics, and demonstrate the chief benefits of mathematics in God’s world. How? Tie the subject to the physical creation – primarily science. The great 19th century mathematical polyglot Carl Friedrich Gauss was fond of stating, “Mathematics is the Queen of the Sciences.” In this context, we should motivate, interpret, and apply mathematics in a classroom with windows wide open to God’s wonderful world (e.g., the honeycomb, the rainbow, sound, optics, mechanics, astronomy, etc.) and include wherever possible the broader implications, largely of cultural heritage, of what mathematics has accomplished.

The use of history as a pedagogical guide in mathematics teaching is extremely important (including the history of technology – a much-neglected topic). Armed with knowledge of God’s providential control of history and a biblical worldview, mathematical topics are greatly enhanced by an understanding of their associated history and personnel.¹⁴

A student who has a “taste” of “mathematics-heavy” in the context of these three proposals will be educated in a truly biblical fashion. By that I mean that the student will have experienced the joy and pleasure of, in the words of Van Til, “thinking God’s thoughts after Him.”

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Like an ellipse with two focal points, I believe biblical Christians should concentrate their mathematical reform endeavors in two key areas. First, recognizing the biblical stress upon mentoring (i.e., discipleship), one focal point should center on teachers and/or parents. As the 21st century progresses decade by decade, may God in His mercy rise up an army of instructors willing to do two things. First, repent of relying upon the “sieve of unbelief.” Second, transform their mathematics teaching by renewing their minds in the biblical worldview and reinterpreting their subject accordingly (Romans 12:1-2). May these teachers not muddle the minds of their students with disconnected particulars, but may they kindle in them the fire of the Keplerian ethos according to Psalm 111:2, “The works of the Lord are great, studied by all who have pleasure in them.”

The second focal point, closely tied to the first, should be the curricula (i.e., textbooks). The task of developing a distinctively biblical Christian mathematics curriculum is the vision of the author of this essay (starting with a set of high school textbooks). The task is a daunting one because of what it demands both in time and effort. The goal is to generate a set of books that manifests, borrowing from the words of Kepler, “the glory of God’s works, as much of its infinity as the narrows of my intellect

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can apprehend.” May God grant His gracious approval upon such a vision and may it bear fruit that will remain for future generations to build upon.

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Endnotes

- 1 Morris Kline, *Mathematics: The Loss of Certainty* (Oxford: Oxford University Press, 1980), pp. 353-354.
- 2 David Howarth, *We Die Alone* (New York: The Lyons Press, [1955] 1999), pp. 126-127.
- 3 Cornelius Van Til, *Why I Believe in God* (Philadelphia: Committee on Christian Education, Orthodox Presbyterian Church, n.d.).
- 4 Cornelius Van Til, *The Case for Calvinism* (Philadelphia: Presbyterian and Reformed, [1963] 1979), p. 24.
- 5 Johannes Kepler, *Epitome of Copernican Astronomy & Harmonies of the World*, trans. Charles Glenn Wallis (Amherst: Prometheus Books, [1618-1621, 1939] 1995), p. 240.
- 6 An example of the mustard seed way is the Puritans of 17th century England. The high proportion of Puritans among English scientists in this century, also called the “century of genius,” is all the more striking when one considers the fact that the Puritans were never more than about four percent of the English population. See David Little, *Religion, Order and Law* (New York: Harper Torchbooks, 1969), p. 259.
- 7 I may challenge some sacred cows here, but I am referring specifically to the popularity in Christian schools (home school and day school) of the Saxon Math series. This curriculum may be useful as a “stop gap” in lieu of something better but let us resolve to move on to something that is better.
- 8 Literally, the Hebrew word for glory means “heavy or weight.” These words suggest the concept of significance or honor.
- 9 There are a handful of non-confessional textbook writers, due to God’s gracious purpose, who have been able to make proximate sense and connection of the particular facts of mathematics, but not ultimate sense and connection (i.e., the biblical God is the author and unifier of these facts). See the textbooks written by Harold R. Jacobs as an example (published by W. H. Freeman).
- 10 Arithmetic was studied by the esoteric Greek philosophers and logistica was performed mainly by Greek slaves.
- 11 For example, one goal for the study of regular polygons (square, triangle, pentagon, hexagon, etc.) could be the

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analysis of packing problems and asking questions like: Why does the honeycomb consist of tessellated regular hexagonal prisms and what does this teach us concerning the God who created the bee to build these structures in such a manner?

12 We can thank the Greeks again for this tendency to divorce the abstract from the concrete.

13 Alfred North Whitehead, *Science and the Modern World* (London: Free Association Books, [1926] 1985), p. 41.

14 I found it useful to quote mathematicians (along with other scientists and philosophers) at the beginning of math class; a technique that jump-started many world view discussions.