MATHEMATICS EDUCATION IN A REFORMED, CHRISTIAN SCHOOL

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ABSTRACT

Many humanists deny God the credit for creating mathematics and attribute mathematics to the genius of human reason. But mathematics is not a secular subject; its content is not divorced from the Creator and His Creation.

Yet, Christian mathematics teachers often struggle with how to make their teaching distinctly Christian. Especially in schools like Covenant Christian High School, this author and his colleagues struggle to make mathematics education distinctly Reformed.

Thankfully, there is a Reformed, Christian approach to mathematics education. The basis for this view is the confession that God created the world in six literal days and that the Bible is the guiding light for all studies. Particularly in mathematics, the splendor of His Creation can be clearly seen. Mathematical concepts are perfectly universal, remarkably useful, and stunningly beautiful.

These point to God, not humankind, as the Inventor of mathematics. Therefore, mathematics education in a Reformed, Christian school should be a study of human discovery and development in light of God's creative work and sovereign sustaining power. This suggests three goals of Reformed mathematics education: to know the beauty and work of the covenant God, to prepare for lifelong learning and occupation, and to enhance academic thinking and writing skills.

This project may serve as a precursor to textbooks and other curricular material that help teachers realize the Reformed view of mathematics.

CHAPTER ONE: PROJECT PROPOSAL

Problem statement

To express a Reformed, Christian perspective of mathematics at Covenant Christian High School is necessary, but it is also difficult. Mathematics students need more than facts and skills; they must be shown the significance of mathematics. Thus, it is vitally important for students to see the perfect wisdom of God in the mathematical universe. However, teaching mathematics from a Christian perspective is notoriously difficult; some have even claimed that mathematics is completely secular. Understandably, this author is distressed when he assesses his own instruction to be Christian education that is often not Christian at all.

Importance and Rationale for the Project

To understand the importance and rationale of this project, it is necessary to understand the significance of Reformed, Christian education to the Reformed faith, the importance of combining this perspective with mathematics instruction, and the shortage of techniques and curriculum materials available for teachers.

Reformed, Christian education. Christian education is Christ-centered education. It acknowledges that the school and its disciplines have everything to do with Christ Jesus. "…All things were created by him, and for him. And he is before all things, and by him all things consist" (Colossians 1:16, 17 – King James Version).

More specifically, a *Reformed*, Christian education has an old tradition dating back four centuries. Certainly it is Christian education; certainly it is Biblical education. In his book Telling the Next Generation, Harro Van Brummelen (1986) cites a preface written by Van Mill in the 1860s who equated the word *Reformed* with the word *Biblical*.

The term "Reformed" refers to a segment of Christianity which has roots in the Protestant Reformation in Europe in the sixteenth century. Martin Luther was a prominent leader in that reform, but the Reformed community today especially lays hold on the Biblical teachings of John Calvin. French by birth, John Calvin was a powerful preacher and prolific writer who worked in Geneva in the mid-sixteenth century. His sermons, his commentaries on the Bible, his writings, and his views on many aspects of life have come to be known today as Calvinism (Kuyper, 1898). *Reformed* means *Calvinistic*.

In the seventeenth century, the Calvinist branch of Christianity developed more fully in the Netherlands, culminating in the great Synod of Dordt in 1618 and 1619 (Bruins & Swierenga, 1999). Today, a Reformed community is primarily one that endorses the Calvinistic interpretations of Scriptural truths as explained by John Calvin and the church leaders at the Dordt synod. These truths include the doctrines

of salvation by grace alone, the covenant that God establishes with His chosen people, and the mandate to put the Bible into the hands of every believer (Engelsma, 1971). *Reformed* means holding to the confessions of Dordt.

Since Calvinism covers all spheres of life, the Reformed faith also includes education. It is interesting to note that both main branches of the Reformation, Lutheran and Calvinistic, called for Christian education in the home and in Christian schools. Luther promoted the establishment of new Christian schools in Germany because children are within the covenant, the community of believers. There exists then a covenant calling to educate children in the fear and knowledge of the Author of that covenant (Hoeksema, 1927; Engelsma, 1971). Calvin, too, and the Reformed church today maintain that since God gathers many of His people in the line of generations, the children of believers must be reared and instructed in the fear of God (Engelsma, 1971).

> We will not hide [God's law and works] from their children, showing to the generation to come the praises of the Lord, and his strength, and his wonderful works that he hath done… that the generation to come might know them… (Psalm 78: 4, 6).

God decreed to Abraham, "And I will establish my covenant between me and thee and thy seed after thee in their generations for an everlasting covenant, to be a God unto thee, and to thy seed after thee" (Genesis 17:7). The basis for Reformed education is the covenant that God unilaterally established with believers and some, but not necessarily all, of their children.

For the children of believers, Reformed education is unique in itself. The principles of Reformed education make it distinct from secular education and even

other forms of Christian education. Reformed education bears distinctive marks regarding the Bible, the teacher, and the goal of education.

One principle is the place of the Bible in education. Van Brummelen says that Christian education is not merely the addition of Bible courses or the use of Bible texts for penmanship; the Bible is a rule and guide in a "search for truth" in every subject (1986, p. 28). Engelsma (1971) and Oppewal (1963) concur and clarify the matter by insisting that the Bible is not alongside the curriculum, but central to all the subjects. First, the Bible is to be used in the daily classroom devotions of teachers and students. Secondly, the truths of Holy Scripture are "the light, the foundation, and the rule for every subject that is taught" (Engelsma, 1971, p. 258).

Another distinguishing principle is the role of the teacher. It is true that parents are primarily responsible for the education of their children and must do so through the home. However, parents usually cannot educate their own children to live and work in today's world and so like-minded parents join together to hire like-minded teachers and establish schools. Teachers are set up in the Christian schools to assist the parents in their duty. During the school day, these teachers stand in the place of the parents; the school is an extension of the home (Engelsma, 1981; Huisken, 1998).

Finally, a critical mark of Reformed education is its mission and goal. Martin Luther suggested two purposes of education. The spiritual purpose is the welfare of the souls of boys and girls, and the temporal purpose is "enabling children to live and work as responsible Christians in the various spheres of earthly, temporal life"

(Engelsma, 1971, p. 181). According to W. R. Niblett (1960), the goal is to teach students that God is the Creator so they will learn to reverence His whole creation. The Canadian educator Jan Waterink (1954) painstakingly pieced together his own vision statement for Reformed, Christian education:

> The forming of man into an independent personality serving God according to His Word, able and willing to employ all his God-given talents to the honor of God and for the well-being of his fellow creatures, in every area of life in which man is placed by God (p. 41).

This aim makes Reformed education distinctive.

Importance of integrating mathematics and the Christian perspective. The rationale for this project lies in the need to integrate this view of Reformed education with the mathematics instruction at Covenant Christian High School. The word *integrate* means to blend, or combine. To the author of The Pattern of God's Truth, it implies bringing parts together to make a whole; it is a "union" of curriculum and school life with "the infinite pattern of God's truth" (Gaebelein, 1954, p. 9). This author believes that this integration is more accurately a "bringing out" the Christian perspective from within the body of mathematics. Throughout this project, this will be the connotation of the term "integration."

Gaebelein (1954) speaks fairly and critically of Christians when he points out the readiness to elevate God's Word as truth but a failure to see the breadth of it. Academic subject areas such as geography, chemistry, and mathematics do not pertain directly to matters of salvation, but are nevertheless a "discoverable" part of God's truth (p. 22). He merely echoes what the Bible declares about God's truth also being manifest in creation. "The heavens declare the glory of God; and the

firmament showeth his handiwork" (Psalm 19:1). Mathematics instruction must display God's handiwork.

From the elliptical orbits of the planets to the fascinating geometry within snowflakes and mineral crystals, these statements continue to ring true and the *need* to integrate is apparent. "In the light of such wonders, we have no business to think of mathematics as an entirely secular branch of learning" (Gaebelein, 1954, p. 61). Larry L. Zimmerman (2000) agrees, "If mathematics *is* the basic language of creation, its nature is to reveal God, and its purpose is to glorify God; it *must* be desecularized" (p. 51).

Zimmerman (2000) goes on to note the difficulty of integration. It must be done, but "*how to* is a task which bears down heavily. Especially is this true in mathematics" (p. 52). Gaebelein (1954) concurs that it is one thing to propose but ever so much more difficult to *do*.

Current need for materials. Perhaps it is the difficulty of the task that cultivates the final rationale for this project. Drawing out the Christian perspective from mathematics is certainly difficult. In fact, some authors on the subject of Christian education omit any mention of mathematics.

Norman De Jong (1969) discusses history, literature, sociology, natural sciences, music and art. He says that history is good for showing God's providence and common origin in Adam. Literature is ripe for discussion of the human condition; tragedies highlight the plight of sin and comedies mark the shallowness of happiness apart from God. Sociology explores the human condition, science relates

the perfection of God's Creation, and music and art exhibit beauty and record the attempts throughout history to praise or provoke God. Yet nowhere in his book does he make similar mention of mathematics. He simply omits it.

Martin Hegland (1954) discusses how to relate thirteen different curricular and extra-curricular areas to Christian faith and life; none of the thirteen subject areas is mathematics. Nor is it easy to find much research on the topic. Whether or not this is a response to the difficulty of integrating mathematics with the Christian faith, the fact remains that there is an imbalance in Reformed mathematics educational materials.

Background of the Problem

For a full consideration of the problem, one must understand the state of the mathematics curriculum in Reformed, Christian schools. First, however, it is necessary to go back even farther to the roots of Covenant Christian: the origin and history of Reformed, Christian schools.

Brief history of Reformed, Christian schools. As stated earlier, reformers such as Martin Luther and John Calvin initiated some of the Christian school movement. It was a characteristic of the Reformation not only that education should be thoroughly Christian, but that it should be for those in the ministry *and the laity*, male and female alike (Engelsma, 1971). However, the idea of parental, Reformed day schools had not yet taken hold. Luther, for one, insisted that it was the obligation of the German civil authorities to establish the proposed Christian schools (Engelsma, 1971).

The Reformed, Christian schools of today find their root in Calvinism as it blossomed in the Netherlands. The seventeenth century was the golden age of Calvinism for the Dutch people, culminating in the National Synod of Dordt of 1618 and 1619. The Synod of Dordt marked a high point because it resolved a major doctrinal issue and produced a new creed, the Canons of Dordt, a new church order, and a much needed clarification of the Reformed doctrines (Bruins & Swierenga, 1999).

Such an age did not last. By the early nineteenth century, the humanistic ideas of the Enlightenment had crept into Dutch Calvinism. The once staunchly Calvinistic church lost some of its doctrinal integrity and departed from the standards of Dordt. By the time Napoleon came through in 1795 and King William I of Orange restructured the state-church relationship in 1815, the church had lost its religious autonomy and become "an arm of the state" (Bruins & Swierenga, 1999, p. 10-11). Some of the people still held to those ideas propounded at Dordt; they opposed the new wave of changes. Especially in the rural areas and at the University of Leiden, opposition mounted when the state church mandated the use of a hymnal which included non-Reformed songs (Bruins & Swierenga, 1999).

Matters came to a head when a group split from the state church. The Afscheiding (Secession) of 1834 was a reaction to a decline in doctrinal purity in the state church and a lack of Reformed distinctiveness within the schools (Bruins & Swierenga, 1999; Oppewal, 1963). Led by Henrik de Cock, Henrik P. Scholte, and Albertus C. Van Raalte, the Secession of 1834 set out to return to the Reformed

standards of Dordt and establish their own Christian schools. Bruins and Swierenga (1999) record that almost immediately fines were levied against these Afscheiding leaders and they faced jail time for civil disobedience. Persecution eased and quieted later on, but the seceders were soon to take their ideas over to America.

Although the Dutch never felt the emigration fever quite like the Germans and Irish did, over 13,000 Afscheiders emigrated to the United States between 1845 and 1880 (Bruins & Swierenga, 1999). In 1847, the Rev. Albertus C. Van Raalte, one of the original secession leaders, established the small colony of Holland in western Michigan (Bruins & Swierenga, 1999).

Across the Atlantic, the new Dutch immigrants received some assistance from members of the Reformed Church in America (RCA). In spite of the help, the small group at Holland struggled in its new environment (Bruins and Swierenga, 1999). Trouble was brewing again a few years later when the group in Holland joined the RCA denomination. Bruins and Swierenga (1999) state that some of the members in Holland disagreed with the views and practices within the RCA, so another secession in 1857 formed the new Christian Reformed Church (CRC). Sixty-seven years later, another split in the CRC would form the Protestant Reformed Churches, the denomination of the founders of Covenant Christian High School.

Back in the Netherlands, there was still tension. Some people were still concerned about the "gaping cracks in the dike of Dutch Reformed orthodoxy" (Cammenga, 1998, p. 33). The result came more than fifty years after the Secession of 1834 when Dr. Abraham Kuyper led a new secession from the state church, called

the Doleantie (Cammenga, 1998). In many ways, Kuyper was a dominant force. He was the foremost preacher, reformer, thinker, author, and politician in the Netherlands from 1880 to 1920 (Cammenga, 1998; Van Brummelen, 1986). Kuyper's early writings were solidly Reformed (Engelsma, 1998). But Kuyper later developed the doctrine of common grace as the basis for broad vision that promoted reforming a humanized world (Terpstra, 1998). Kuyper's thinking soon impacted the fledging Christian school movement in America.

Although the CRC was establishing Christian schools in western Michigan by Kuyper's time, they were very small (Van Brummelen, 1986). But by 1920, there were enough schools to band together to form the National Union of Christian Schools (NUCS). One goal of NUCS was to write distinctively Reformed curricula. But the group was relatively small and it was difficult to support major projects. That would soon change. Throughout the mid-1900s, the association grew and spread into Canada. With the addition of the Canadian schools in 1978, NUCS was renamed Christian Schools International (CSI).

As CSI grew, a disparity between the philosophy of the Secession of 1834 and the philosophy of the Kuyperian camp was left unresolved. The Kuyperian view is an extension of Kuyper's later ideas. Kuyperians aim to transform culture by helping students become reforming influences (Van Brummelen, 1986; Van Brummelen, 1972). Using standard Kuyperian terminology, Stronks and Blomberg (1993) and Vryhof (1991) also maintain that the goal of education is prepare students to have a transformational, or Christianizing, effect on society. This extension of Kuyperian

Calvinism, redeeming the world for Christ, became the dominant view in CSI as it grew large enough to produce curricular materials.

The philosophy of the Secession of 1834 maintained the Calvinism of the Reformed tradition and the Synod of Dordt. This view held that the goal of Christian education is to maintain an antithesis of fellowship with God and separation from the world. Professor Russell Dykstra who is a former teacher in a Reformed, Christian school and current professor at the Protestant Reformed Theological Seminary, views education this way. Both Dykstra (1998) and Engelsma (1981) agree that the goal of Reformed, Christian education is to prepare students for fellowship with God in the covenant and an antithetical life apart from the world.

Mathematics curriculum in Reformed, Christian schools. The history of Dutch Calvinistic schools explains the background of Reformed schools like Covenant Christian High School; the "covenantal-antithetical" goal especially should give some insight into the distinctiveness of the Reformed curriculum. Next, a deeper probe into mathematics curriculum is necessary: what it is *not*, what it *should* be, and what it is today.

Stated negatively, a good mathematics curriculum is *not* arithmetic with Bible texts and moral lessons. David Smith (1999) poses the question: "Is it adequate… to add Bible verses to curriculum materials in order to make them 'Christian'? If learners are presented with mathematical problems focusing on, for instance, sales figures for Bibles at a Christian bookstore, what are they actually learning about the Bible?" (p. 29). Smith's point is clear. The Bible should not be used as a book of

moral quotations and lessons to be superficially injected into story problems and arithmetic exercises. Yet he claims that some Christian curriculum materials cater to this view.

Van Brummelen (1986) depicts the narrowness of this view with the examples of two former educators. One educator saw integration of faith and mathematics in the classroom as moral discussions about issues related to both mathematics and the Christian life: overcharging vs. honesty, underpaying vs. fairness, and wise investing. The other suggested learning arithmetic so students would not later use it for "thievery" in their occupations (as cited in Van Brummelen, 1986, p. 39). Such activities are not wrong, but they are not meaningful ways to show the true Christian nature of mathematics.

Correct, meaningful integration stems from the awareness that "the world of mathematical precision is God's world" (Gaebelein, 1954, p. 64). James Olthuis agrees with Engelsma (1971) and Gaebelein (1954) that the Bible needs to be *central*, not peripheral: "Creation can only be understood in relation to God's word which brought creation into being and continues to uphold it" (as cited in Zimmerman, 2000, p. 42). Mathematics curriculum should present the world and its mathematical patterns in the light and on the foundation of God's Word, the Bible (Engelsma, 1971).

Ideally, the mathematics curriculum in Reformed schools will do this. In reality, the current state is far from ideal. In this author's classroom, there is a lack of meaningful integration. Others demonstrate that there is a shortage of good materials

(De Jong, 1969; Hegland, 1954) and the process is difficult. Gaebelein (1954) calls mathematics "the hardest subject to integrate" and wonders exasperatedly if anyone can do it (p. 57). History, literature, and science are easily integrated, but the Christian perspective of mathematics is far more difficult to bring out.

Statement of Purpose/Goals

The overall purpose of this project is to outline the Reformed, Christian perspective of mathematics and describe specifications for integrating this perspective in mathematics education. This purpose has several aspects:

a) Student growth – Students of mathematics in a Reformed classroom need to understand that the purpose of mathematics is ultimately the praise and glory of the Creator. The primary objective of mathematics education, then, is that students will better know their Friend-Sovereign by means of studying the patterns in His Creation. Other objectives are subservient to this.

b) Teacher development – Another goal of this project is to increase this author's knowledge and ability to teach mathematics from a Reformed perspective. At least in part, this objective will be a tangible result. This project will produce a few supplemental curricular materials.

c) Better parental awareness – The parents who vowed a Christian education for their children should also gain a better understanding of the mathematics perspective at Covenant Christian. The objective is to produce new course descriptions, syllabi, and articles for reading.

d) Glory and honor of God – Mathematics is the language of God's Creation. Reformed education is the rearing of God's covenant children. Therefore, the goal of this project on mathematics education is the glory of the God who saves His chosen people and is the grand Architect of the universe.

Limitations of the Project

Several limitations must be mentioned here—limitations within the project and factors outside that restrict the scope of the work.

Within the project, there are issues that may arise that do not receive full consideration at this time. These pertain to other religious beliefs, other schools, and other subjects.

It is not the immediate concern to address the belief systems of other world religions or even of other segments of Christianity: Roman Catholic, Lutheran, etc. This project is specific to the Calvinistic branch of Christianity. More specifically, the Reformed beliefs in the tradition of the Synod of Dordt are emphasized while the Kuyperian tangent is scarcely mentioned.

With regard to curriculum, this project is not intended to resolve curriculum issues for non-Reformed schools whether public or private. Not even the advantages and disadvantages of establishing Christian schools are discussed here. The focus here is on Reformed, Christian schools like Covenant Christian High School.

Although other academic disciplines are mentioned at times, this project is limited to mathematics. History, science, languages, music, and a host of other

subjects must also be taught from a Christian perspective, but this project aims solely at the mathematics curriculum.

Two other factors exist which have a restricting influence on the magnitude and breadth of this work. The first is a problem of research. Compared to other subject areas, there is relatively little written about this topic. What has been written in books and journals is not easy to find at a secular university library or in an ERIC database. Therefore, the first section of the literature review relies heavily on The Pattern of God's Truth by Frank Gaebelein (1954) and Truth and the Transcendent by Larry L. Zimmerman (2000).

The second problem is an issue of authorship. One might see irony in an attempt of a finite creature to explain mathematics, a subject of infinite magnitude. The limitations are readily apparent. No one can even finish writing all the decimal places to the most common irrational number: $\pi = 3.14159\ldots$. Likewise, Zimmerman (2000) highlights the interesting equation $.999\ldots = 1$. Any child can write the right side of the equation, but only God could fully write the left (p. 16). Mathematics is inestimably greater than man's finite mind.

Key Terms

Creation—The Biblical, Reformed view is that God created heaven and earth by the power of His Word. As recorded in the book of Genesis, this was done around 6,000 years ago in six, approximately 24-hour days. God also daily sustains His Creation.

Covenant—the bond of fellowship that God establishes unilaterally with His people.

Integration—sometimes refers to a union of Christian beliefs and the field of mathematics; more properly, an expression of the Christianity *within* mathematics; also not to be confused with the method of determining integrals in calculus.

Reformed, Christian—Although *Christian* is an accurate, honorable term, its abuse elsewhere creates a need for additional emphasis. *Reformed* is also an adequate term, but only for those who are familiar with Calvinism and the Reformed doctrines. Moreover, *Reformed, Christian* is used with punctuation to avoid any confusion with the denominational term *Christian Reformed*. In essence, *Reformed, Christian* simply means adherence to *biblical* truths as these are so carefully expressed in the three Reformed confessions: Heidelberg Catechism, Belgic Confession, and Canons of Dordt.

CHAPTER TWO – LITERATURE REVIEW

Although much has been written about Calvinism and about mathematics education, relatively little has been written about Calvinism *in* mathematics education. The little that has been written is divided into two categories. The first deals with how philosophies are related to mathematics. Humanists and Christians have entirely different views regarding the origin, nature, and purpose of mathematics. The second part involves how to show students the Christian view while teaching in a Reformed classroom. Merely having a Christian view of mathematics is not a goal in itself. Issues of pedagogy and curriculum must still be addressed.

The Christian and Humanistic Perspectives of Mathematics

On the origin and nature of mathematics.

Two main philosophies of mathematics center on the origin and nature of mathematics. Undoubtedly, mathematics possesses many remarkable characteristics of rare elegance and quality. But, the divisive issue is whether God created mathematics or mathematicians invented it.

This is not a misplaced question. Whether or not God created mathematics is fundamental to a philosophy of mathematics. In his book Truth and the Transcendent: The Origin, Nature, and Purpose of Mathematics, author Larry L.

Zimmerman (2000) insists that "to claim that philosophy has nothing to do with mathematics is like claiming that cooking has nothing to do with food" (p. 46). Questions about the origin of mathematics are inherently philosophical and religious. In the mathematics chapter of his book The Philosophy of the Christian Curriculum, author R. J. Rushdoony (1981) states, "The issue in mathematics today is root and branch a religious one" (p. 58).

Rushdoony's use of the word *today* implies that this is also not a dead question. Some are still searching for an answer. These are primarily mathematicians who marvel at the beauty and perfection of mathematics but cannot explain it. Morris Kline says, "In the end, we just don't know why mathematics works as it does. We're faced with a mystery" (as cited in Zimmerman, 2000, p. 36).

Kline and others claim that mathematics is a human invention. While admitting that mathematical formulas have astonishing value in the way they apply to so many situations in the universe, Kline (1980) maintains that "nature's laws are man's creation. We, not God, are the lawgivers of the universe. A law of nature is man's description, not God's prescription" (p. 97). John W. N. Sullivan elaborates on the term *lawgiver*. "We are the lawgivers of the universe; it is even possible that we can experience nothing but what we have created, and that the greatest of our mathematical creations is the universe itself" (as cited in Zimmerman, 2000, p. 24). Even the extraordinary Albert Einstein puzzled over the question: "How can it be that mathematics being after all a product of human thought… is so admirably appropriate to the objects of reality?" (as cited in Zimmerman, 2000, p. 35).

Like Einstein, humanists who claim that mathematics is not part of God's creation find themselves at a loss to explain the complex beauty and sheer power of mathematics. Under the collective pseudonym Nicolas Bourbaki, a group of French mathematicians stated that God either does not exist or has nothing to do with mathematics.

> …There is an intimate connection between experimental phenomena and mathematical structures [which] seems to be fully confirmed in the most unexpected manner by the recent discoveries of contemporary physics. But we are completely ignorant as to the underlying reasons for this fact (as cited in Zimmerman, 2000, p. 27).

Nobel Prize winner Eugene Wigner writes openly of his own confusion, "It is hard to believe that our reasoning power was brought, by Darwin's process of natural selection, to the perfection it seems to possess" (Zimmerman, 2000, p. 6). Such mathematicians are brilliant men and women, but Gaebelein (1954) says they fall under the description of II Timothy 3:7, "Ever learning, and never able to come to the knowledge of the truth" (p. 11). Some of the most intelligent men and women in the world are still hoping to find an answer.

Frank Gaebelein (1954) is also quick to point out that those who do acknowledge God as Creator have no reason to boast. Such knowledge does not come by one's own power and goodness, but through the unmerited favor (grace) of God (Gaebelein, 1954). Having their eyes opened by grace, Reformed Christians believe that mathematical universe was created by God during the creation week. They assert that mathematics is God's amazing creative work, not a human invention (Gaebelein, 1954; Niblett, 1960; Rushdoony, 1981; Van Brummelen, 1988;

Zimmerman, 2000). The Lord God "…appointed the ordinances of heaven and earth" (Jeremiah 33:25).

Some even say that to study mathematics is to think God's thoughts after Him. Zimmerman (2000) claims that prior to 1850, this was the prevailing view in American education. Some people still hold to this view, although the secular view is far more prevalent (Gaebelein, 1954; Rushdoony, 1981).

To say that human mathematicians *invented* mathematics is an improper use of the verb. Two analogies highlight the contradiction of the humanistic view. To say that mathematicians invented mathematics is like saying that Columbus invented America (Nickel, 1990; Zimmerman, 2000). But he did not invent a continent; America pre-existed his discovery. Columbus merely discovered it anew for the European world. Oddly, the second analogy is adapted from a prolific humanist author, Morris Kline, who pointed out that the study of mathematics is like mining ore for precious metal. When treasure is found, no one can claim to have created the metal; the metal was pre-existent (Zimmerman, 2000). So it is with mathematics. The principles, the patterns, and the perfection are pre-existent to human discoveries of the symbols devised to explain them. In fact, the Greek word μαθημα (mathema) means "that which is learned" not "that which is produced" (Zimmerman, 2000, p. 31).

All mathematicians see the marvelous complexity of the perfect patterns. But acknowledging this does damage to the argument of the humanists who say that

mathematics is a product of the human mind. Zimmerman (2000) is careful to point this out:

> Employing words like 'remarkable,' 'surprise,' 'unforeseen,' 'unexpected,' and 'mysterious,' Kline and Bell are tacitly admitting that the unity of mathematics shears the pins from their assumption that mathematicians invent mathematics (p. 3).

After highlighting the contradictions, Zimmerman (2000) also introduces ideas that shed more doubt on the notion that mathematicians have invented mathematics. These include the depth and infinity of mathematics, its unexpected usefulness, and simultaneous discoveries.

The concept of infinity is difficult to explain, but hard to miss. Even in arithmetic, for example, there are infinitely many integers. Students can scarcely comprehend millions and billions, much less the infinitude of numbers. It would take a person almost thirty-two years to count, once a second, up to one billion. Yet there are billions of billions of integers. And no matter what is assumed to be the largest integer, even a child can prove it is not the biggest by always adding one, and adding one to that, and so on (Zimmerman, 2000).

Zimmerman (2000) also cites the density of the real numbers as a stunning example. Between any two real numbers, x_1 and x_2, there is always another real number x_i. But, of course, there is also a real number x_j between x_1 and x_i. For example, between 2 and 3 exists the real number 2.5. Between 2 and 2.5 exists the real number 2.1; between 2 and 2.1 exists 2.06; and so on. It soon becomes apparent that there are infinitely many real numbers between any two real numbers, no matter how close they seem to be on the number line. The ramifications of this idea on the

countless intervals that could be considered are "stunning" and show that "there is 'more than man' in mathematics" (Zimmerman, 2000, p. 56)

The great mathematical prodigy Blaise Pascal spoke of two infinities that are found "in everything"—infinite smallness and infinite greatness (Zimmerman, 2000, p. 58). In his treatment of infinity, Zimmerman (2000) points to calculus. The approximation of definite integrals with Riemann sums leads to the consideration of infinitely many rectangles; limits show the behavior of functions as x goes to infinity; asymptotes demonstrate how a curve can forever continue to approach a line—never failing to get closer and closer, yet never quite touching the line (Zimmerman, 2000).

Even if humankind could invent something of infinite size, there are other issues to be explained away. For example, it is a well-known fact in the field of mathematics that Sir Isaac Newton in England and Gottfried Liebniz in Germany discovered calculus almost simultaneously. Is one to believe that sheer coincidence caused two independent minds to devise identical inventions? The coincidence theory gets much harder to believe when Zimmerman (2000) presents a longer list of simultaneous, independent discoveries compiled by William F. Ogburn: Newton's and Sir Edmund Halley's law of inverse squares, John Napier's and Jobst Burgi's logarithms, and Karl Gauss' and F. Legendre's least squares principle. This is akin to two artists or musicians simultaneously creating identical new paintings or symphonies.

<u>On the remarkable characteristics of mathematics.</u> For a broader perspective, this project goes beyond the origin and nature of mathematics to look at some of its

remarkable characteristics. Again, Zimmerman (2000) is the one who outlines three main areas: the universality of math, its usefulness, and its beauty.

Universality is a characteristic of mathematics that makes it unlike other subjects. For example, the academic study of history changes both in time and place. Over the course of centuries, historical knowledge develops and historical perspectives change. Columbus discovered America from the perspective of fifteenth century European history, but his arrival in the "New World" was not equivalent to discovery in the eyes of the Native Americans already living there. Likewise, the historical label The Great War had to be revised to World War I in light of a second and greater world war. Even views on the American Civil War are different in a Montgomery, Alabama classroom than in an Albany, New York classroom (Zimmerman, 2000).

In contrast, mathematics courses remain the same. In the words of the prominent British mathematician G. H. Hardy, "Archimedes will be remembered when Aeschylus is forgotten, because languages die and mathematical ideas do not" (1941). Mathematics is universal with respect to both time and space. All mathematics fits all other mathematics worldwide—past, present, and future (Zimmerman, 2000).

The extent of this universality, or unity, is astonishing. The mere existence of *number* all over the world and throughout the universe attests to this (Gaebelein, 1954). Dr. Vern Poythress comments on the idea of *number*: "The simplest arithmetical truths presuppose…unity for the world. Two apples remain two apples

while I am counting them; the symbol "2" is in some sense the same symbol at different times" (as cited in Rushdoony, 1981, p. 57). Zimmerman (2000) notes that this is actually another argument against mathematics as a human invention: "The monolithic quality of mathematics simply necessitates interpreting mathematical truth as discovery rather than invention or art" (p. 11).

Mathematics even possesses this quality of unity *within* itself. In a sense, mathematics is universal throughout its own body of discoverable knowledge. For example, there is "a beautiful unity between geometry and algebra" (Zimmerman, 2000, p. 9). Conic sections, the curves resulting from various cross-sections of a cone, have been part of geometry since the time of the ancient Greeks. Yet these same curves are not only describable, but *useful* in algebra as bivariate equations (Zimmerman, 2000).

The term *useful* refers to another remarkable feature in mathematics—its applicability. Mathematics finds application everywhere from the crystallography of snowflakes and minerals to the frequencies of musical sounds and a host of other areas (Gaebelein, 1954).

Music is inherently mathematical; the whole field of music has an abundance of mathematical applications. For example, every musical note has a distinct number of vibrations per second (Gaebelein, 1954). Even the ancient Greeks knew something of this; Pythagoras is credited with the discovery that musical intervals depend on arithmetic ratios (Gaebelein, 1954). Joseph Fourier summarizes the connection:

> All sounds, vocal and instrumental, simple and complex, are completely describable in mathematical terms… [Even the] wailing of a cat is no more complex mathematically than a simple trigonometric function. Those dull, abstract formulas… are really all around us (as cited in Zimmerman, 2000, p. 33).

Mathematics is ever present and ever useful.

As stated earlier, the conic sections (circles, ellipses, parabolas, and hyperbolas) are useful in algebra. Additionally, they are useful in applications of technology. Several of the conic sections are used to chart the movement of planets and comets; parabolas are essential to the study of projectiles and the effects of gravity; others are used in aerospace and automobile industries with regard to aerodynamics (Zimmerman, 2000).

Two irrational numbers, π and e, have the dual distinction of being unifying elements with mathematics as well as a clear testimony to the link between mathematics and the physical world (Zimmerman, 2000). The value for π is generally taken from the ratio of a circle's circumference to its diameter; the value for e is a naturally occurring value in population equations. However, π and e have many intertwining uses in number theory. For example, there is a "simple, striking connection between π and the set of all odd integers:

$$\pi/4 = 1 - 1/3 + 1/5 - 1/7 + 1/9 - 1/11 + \ldots" \quad \text{(p. 14)}$$

The Prime Number Theorem links e to prime numbers and logarithms. More importantly, π and e, the "ubiquitous pair," have wide-ranging applications inside and outside of mathematics: statistics, probability, biology, sociology, and finance

(Zimmerman, 2000, p. 15). And both π and e combine with the imaginary constant *i* in a most unusual and exquisitely simple equation: $e^{2\pi i} = 1$ (Zimmerman, 2000).

It is fair to say that it is unexpected that the constant π, arising out of a simple circle, should have such broad usefulness. This is often the case in mathematics. Not only are mathematical discoveries useful, they are often *unexpectedly* so.

When confronted with the usefulness of mathematics in relation to nature, Nobel Prize winner Eugene Wigner said, "The enormous usefulness of mathematics in the natural sciences is something bordering on the mysterious and…there is no rational explanation for it" (as cited in Zimmerman, 2000, p. 21). In the late eighteenth century, Karl Gauss was one of the first to work with complex numbers (Bell, 1937). Little did he know that two hundred years later, complex numbers would arise in the technical field of quantum mechanics (Zimmerman, 2000). Wigner's response to this: "It is difficult to avoid the impression that a miracle confronts us here" (as cited in Zimmerman, 2000, p. 21).

Other surprises include vectors, probability, and conic sections. Lord Kelvin once claimed that vectors "have never been of the slightest use to any creature" (as cited in Zimmerman, 2000, p. 22). But Zimmerman (2000) is quick to point out that vectors are widely used today in physics and biology. Another example is probability. Bell (1937) ascribes a trivial origin to the study of probability, but he contrasts this with the uses of probability in insurance, statistics, biology, educational assessment, and theoretical physics (Bell, 1937). The conic sections perhaps are the most surprising. Once an "unprofitable amusement," this set of four curves is used in

astronomy, navigation, and physics (Zimmerman, 2000, p. 23). Such unexpected usefulness is remarkable—even beautiful.

Beauty is indeed a hallmark of mathematics. Even a self-professing enemy of God, G. H. Hardy (1941), acknowledged its beauty. "The mathematician's patterns, like the painter's or poet's must be beautiful…. Beauty is the first test: there is no permanent place in the world for ugly mathematics." The humanistic perspective of mathematics does admit the existence of beauty in mathematics.

Christian mathematicians, too, recognize a remarkable beauty in the way mathematics works. They take heed to the words of Job 37:14, "…stand still, and consider the wondrous works of God." For a clear expression of the wonder and beauty, Gaebelein (1954) appeals to the great mathematical prodigy Blaise Pascal who scoffed at the notion of labeling certain concepts as "self-evident truths" (as cited in Gaebelein, 1954, p. 58). Ideas such as time, number, and equality are much more than self-evident; they are completely unverifiable. But this is exactly part of the beauty of mathematics. Gaebelein (1954) quotes Pascal:

> All these truths [including the existence of number, equality, and infinity] cannot be proved. However, since the quality which makes them incapable of proof is not their obscurity, but rather their extreme obviousness that lack of proof is not a defect, but rather a mark of excellence (as cited in Gaebelein, 1954, p. 58).

A remarkable insight! Yet Zimmerman (2000) matches Pascal's description with his own account of the beauty in mathematics.

> It is true that the melody of nature's song can be enjoyed without knowledge of its underlying mathematical structure. If you are privileged to view to creation through a microscope or telescope, to hear the sound of wind or thunder, to hold a baby duck or a baby person, you come to appreciate the

> beauty and power in nature whether you are acquainted with the "Mean Value Theorem" or not. But the lyric of "the music of the spheres" is clearly mathematics, a knowledge of which unveils not only vistas of beauty and power unsuspected before, but also an order, symmetry, and infinitude which stuns and awes the beholder.
>
> Beauty, power, order, symmetry, infinitude—though these characteristics of mathematics are there for anyone, the Christian sees them in their proper light as reflections of God's attributes…. They are beholding beams of God's glory (p. 55).

Any perspective of mathematics must include the beauty of mathematics; a *Christian* perspective sees the beauty, marvels at it, and attributes the glory to God.

A Distinctly *Reformed*, Christian Perspective of Mathematics in the Classroom

Gaebelein (1954) and Zimmerman (2000) are two of the loudest voices maintaining that God created mathematics and that mathematicians discover how it works, not invent its truths. The inherent characteristics of mathematics (universality, usefulness, and beauty) and many of its concepts (infinity, equality, existence of number, etc.) affirm that humankind could not have invented mathematics. Such a view is not an *end* but a *basis*. This particular Christian perspective of mathematics must still be related to the students in the classroom; its goals, methods, and curricular issues must be addressed.

Pedagogical goals: spiritual and temporal. The pedagogical goals of the Reformed view of mathematics are two-fold. As part of Calvinism, the Reformed world-and-life view recognizes that all of life—spiritual *and* mundane, heavenly *and* earthly, eternal *and* temporal—is part of Christianity and is under the dominion of Christ (Hoeksema, 1927). Nothing is completely secular; all subjects are to be taught

and used in a Reformed, Christian light (Hoeksema, 1935). Mathematics education, then, has both spiritual and mundane goals.

The primary goal is spiritual and covenantal. Spiritually, students need to know the Creator and enjoy His covenant fellowship through His evident wisdom, infinity, and immutability. According to the Reformed world-and-life view, a Christian's part in the covenant is a spiritual knowledge of God's attributes through fellowship with Him (Hoeksema, 1927; Huisken, 2000). Van Der Kooy (1925) pinpoints the Calvinistic nature of this spiritual goal: "The central thought of Calvinism is that God is in immediate communion with His own…" (p. 22). This communion takes place primarily through the truths of the Bible and also through a study of God's Creation (Huisken, 2000; Zimmerman, 2000).

Morris (1977) asserts that no dichotomy exists between the truth of God's Bible and the truth of God's Creation, "because there is one God and one universe" (p. 24). Kienel (1978) agrees that the study of truth, whether religious or mathematical, leads back to God because the "God of the Bible is also the God of creation" (p. 30). Creation is to be studied in the light of Holy Scripture.

The goal of seeing God's power and wisdom in His mathematical universe is not a recent development. Centuries ago, some of the famous astronomers and mathematicians pointed out the correlation between mathematics and nature. The famous Polish astronomer Nicolaus Copernicus once said, "So great is this divine work of the Great and Noble Creator!" (as cited in Nickel, 1990, p. 34). The remarkable German astronomer Johannes Kepler prayed, "I give thanks to Thee, O

Lord Creator, Who hast delighted me with Thy makings" (as cited in Nickel, 1990, p. 34). In the seventeenth century, the great Isaac Newton clarified this relation between mathematics and the universe:

> The Supreme God is a Being eternal, infinite, absolutely perfect…. And from his true dominion it follows that the true God is a living, intelligent, and powerful Being; and, from his other perfections, that he is supreme, or most perfect. He is eternal and infinite, omnipotent and omniscient; that is, his duration reaches from eternity to eternity; his presence from infinity to infinity (as cited in Nickel, 1990, p. 39).

In spite of all this, Nickel (1990) reports that "most mathematical pedagogy divorces itself from the context of creation," but the Christian pedagogy *embraces* creation because the study of mathematics as part of creation, "will eventually lead the teacher and student to the Creator" (p. 109). This is the primary goal of mathematics education in a Reformed classroom.

This knowledge should nurture a beautiful, enjoyable fellowship. Therefore, another aspect of this goal is to help the students *enjoy* the beauty of God's mathematical work. In the area of language studies, Vande Kopple (1999) encourages the study of grammar not only to develop academic skills, but also to appreciate the beauty and intrigue of words and language structure. Likewise in mathematics, teachers must encourage their students to be fascinated by mathematics by showing them how to enjoy the elegance of God's work in Creation (Niblett, 1960). Steensma and Van Brummelen (1977) agree that students should be taught to sense the wonder of mathematics. Hanko (2000) states it best: "Creation is a symphony of heavenly themes" (p. 156).

In addition to this spiritual primary goal, the Reformed perspective of mathematics brings two temporal goals to the classroom. The first of these two is the adequate training of students to be productive in everyday life. The training of students, "to live and work as responsible Christians in the various spheres of earthly, temporal life" is a goal that has been recognized for a long time by the proponents of Christian education (Engelsma, 1971). Particularly, a solid background in mathematics has become increasingly important for workers and their families in today's high-tech society (Niblett, 1960).

The other temporal goal is an academically oriented goal. The first-century church at Colosse was encouraged to do all things well and whole-heartedly "…for ye serve the Lord Christ" (Colossians 3:24). In line with this biblical principle, both Niblett (1960) and the National Union of Christian Schools (1953) recommend mathematics as a study that promotes mental aptitude and as an exercise that stresses accuracy and neatness. Other academic disciplines also emphasize the importance of correctness and accuracy of answers as well as neatness and clarity of written communication, but these qualities are especially important in mathematics.

The combination of these three goals has a distinctly Reformed flavor. The spiritual goal reflects the Dutch Calvinistic confessions of Dordt; the temporal goals embrace a non-transformational worldview of living all areas of life to God's praise.

The spiritual goal is Reformed in its attitude toward Creation. Creation is not a stand-alone revelation of God; God's revelation is one entity with two parts (Hanko, 2000). Therefore, the study of God's perfect wisdom in mathematics must be done in

the light of Holy Scripture. Even some nominally Reformed theologians and educators deny this dependency; their view is that the Bible is a special revelation and the Creation is an independent, more general revelation (Hanko, 2000). Hanko (2000) points out the dangers and contradictions encountered by this view. He asserts that the two aspects of God's one revelation are not independent, nor do these contradict each other; this is biblical, confessional, and Reformed (Hanko, 2000).

The temporal goals are also Reformed. The intention to prepare students for living and working in every sphere of life is a key part of the Reformed world-and-life view (Engelsma, 1998; Huisken, 2000). In contrast, Kuyperian goals have been extended well beyond this. Engelsma (1998) expresses the Kuyperian temporal goals:

> According to Abraham Kuyper, common grace is the basis of the Calvinistic worldview…. First, it restrains sin in the ungodly, so that they are not totally depraved. Secondly, it enables the ungodly to see and approve the truth made known by general revelation and to do what is good and right in natural life. Thus, they can develop the creation positively…. And third, common grace permits Christians, indeed *calls* them, to join hearts and hands with the ungodly in this positive development of culture (p. 366)

Especially with regard to the Biblical truth of God's grace, this is a departure from the Reformed, biblical confessions of Dordt. God's grace is particular to some, not common to all (John 6:39; John 17:6; Acts 13:48; Ephesians 1:4; Romans 8 and 9), and Christians are called to be *in* the world but not *of* the world (John 17). The Reformed temporal goals are aimed at an antithetical life in the world, not a Kuyperian transformation of culture and society.

Pedagogical methods. Christian teachers need to know methods by which they may accomplish the goals of Reformed education. They may not be indifferent to methodology (Van Der Kooy, 1925). First, it is useful to contrast the poor methods with the good. One defective method involves the separation of mathematics from anything spiritual. Nickel (1990) criticizes the view that only Bible courses deal with sacred and spiritual issues, while mathematics is completely separate and secular. This is not Christian education. Another non-Reformed method that Nickel (1990) criticizes is mathematics education that artificially decorates traditional content with Bible verses and spiritual lessons. Hoeksema (1935) agrees that this is not meaningful, Christian education.

The proper pedagogical method for mathematics education in a Reformed, Christian classroom is integration—consistent, deliberate study of mathematics as the physical-spatial-numerical part of God's creation (Gaebelein, 1954; Nickel, 1990; Van Brummelen, 1988; Zimmerman, 2000). Although it is difficult, bringing out the Christian perspective can be done in conjunction with various teaching strategies.

Gaebelein (1954) notes the difficulty of the task in his subtitle, Problems of Integration in Christian Education. In the book, he clarifies the problem. While the problem of the secular view of mathematics is the search for a unifying framework, the problem of the Christian view is the application, or integration, of a clear, unifying framework (Gaebelein, 1954). Specifically, *mathematics* is "the hardest subject to integrate" with a Christian view (Gaebelein, 1954, p. 57). Zimmerman

(2000) deplores his own faculty's struggles, "There wasn't much we could do, except tell our students that mathematics was created by God" (p. *v*).

The Christian teacher should not succumb to the difficulty of illustrating the Christian perspective of mathematics in the classroom. Zimmerman (2000) disagrees with Dr. David Neu who insists, "In mathematics, God's revelation is silent. There is nothing to integrate" (as cited on p. 1). There is much to integrate. Although integration is difficult, it is possible.

Possible methods to employ for this integration are common teaching strategies in education. Van Der Kooy (1925) says, "The Christian school is not narrow and exclusive in its attitude toward methodology. It does not hold itself aloof from the methodology which is being developed outside of Christian education" (p. 55). Van Der Kooy (1925) urges that discernment be used in the application of secular methodology, but he opens the door for many methods.

Classroom methodology must adapt to the nature of the created soul of the student (Van Der Kooy, 1925). Teaching strategies that recognize this can be used in Reformed mathematics education. Kienel (1978) endorses several techniques: analogy, contrast, drill and practice, positive student reinforcement, question-and-answer sessions, class discussions, repetition and review, written assessment tests, and visual aids that accommodate different learning styles. These methods are not inherently good or bad teaching tools in this particular integration process; the key is the teacher (Kienel, 1978). Therefore, even the lecture method can be an effective

way to convey the truth and beauty of God's world within mathematics because it presupposes teacher preparedness (Morris, 1977).

Steensma and Van Brummelen (1977) strongly encourage a cross-disciplinary approach. Mathematics does not stand independently, nor does it dominate all the other subjects. Therefore, mathematics teachers should consult teachers in other disciplines about how to bring out the cross-disciplinary nature of mathematics: its history and influence, its implications in science, and how it has been influenced by culture (Steensma & Van Brummelen, 1977).

Nickel (1990) condenses the intent of all these methods with the qualification that mere facts and skills lead nowhere; any teaching method should strive for *understanding*. Whether by lecture, by group discussion, by modeling, or otherwise, the students need to rise to the level of understanding the nature of mathematics and its uses (Nickel, 1990). This is well in line with the general education theory of Bloom and associates (1956); in their taxonomy of the cognitive domain, knowledge is the lowest level while comprehension and analysis are higher levels.

Interestingly, Van Der Kooy (1925) limits the emphasis on understanding. One of the main distinctive features of a Christian school is the willingness to impart "incomprehensible material to the child" (Van Der Kooy, 1925, p. 58). He cites the Dutch professor Herman Bavinck: "The truth is not in need of our approval, rather we are in need of the truth" (as cited in Van Der Kooy, 1925, p. 58). Methodology should teach content and should facilitate the comprehension of the content, but Van

Der Kooy (1925) claims that understanding is not the sole end of all pedagogical methods.

Other curricular issues. Goals and methods do not comprise all of mathematics education. A solid curriculum must also address other issues: the place of the Bible in mathematics instruction, the place of mathematics among the academic disciplines, textbooks, and assessment.

The first issue concerns the appropriate place of the Bible in the curriculum. Reformed theologians insist that the Word of God is not peripheral, but central to all academic subjects (Engelsma, 1971; Hoeksema, 1935). Engelsma (1981) asserts that the very existence of a Reformed school depends on the Word of God; "Scripture defines education" (p. 26). Steensma and Van Brummelen (1977) agree that the Bible is central to curriculum, not as a recipe for all education but as a guide for understanding. Although he does not apply this to a real classroom, Morris (1978) maintains, "Every course [is] based on Scripture, integrated with Scripture, and judged and corrected by Scripture" (p. 144). Such is the ideal place of the Bible in a Reformed mathematics curriculum. Mathematics should be studied in light of Holy Scripture; the two are not separate revelations of God.

Mathematics itself has a proper place among the other disciplines. Mathematics is only part of Creation, not all of it. Even the self-professing humanist Bertrand Russell recognized that mathematics is not the book of nature, but the alphabet of the book (as cited in Zimmerman, 2000). With this in mind, Steensma and Van Brummelen (1977) point out that mathematics is a "servant" among the

academic disciplines, not the "master" of them all (p. 142). One illustration of this is the relation of mathematics to physics. Physics cannot be reduced to pure mathematics. Although mathematics is unquestionably a powerful tool for describing physical aspects of Creation, the field of physics is too complex to be exhausted by mathematical formulas alone (Steensma & Van Brummelen, 1977). A Reformed mathematics curriculum correctly places mathematics *among* the other academic disciplines.

Textbooks are another issue. Kienel (1978) contends that textbooks structure much of the content sequence for any subject. If this is true, then having textbooks that are aligned with Reformed pedagogical goals and methods is vitally important for Reformed mathematics education. Long ago, Hoeksema (1935) was already calling for teachers who understood the principles of Reformed education to develop textbooks. Decades later, Morris (1977) still lamented "the dearth of Christian textbooks" as a serious curricular obstacle (p. 176). Morris (1977) goes so far as to say that if there are no suitable textbooks, then none should be used; the teacher must bear the burden. If no mathematics textbooks suit the Reformed standards, then these must be developed or the teacher must improvise. If more Christian educators took this problem seriously, the problem would soon be solved (Morris, 1977).

No matter what textbooks are used, some consideration must be given to assessment of student learning. Kienel (1978), Morris (1977), Nickel (1990), and Steensma and Van Brummelen (1977) all make references to student comprehension, but none of them describe how to assess student development. However, a

curriculum guide by the National Union of Christian Schools (NUCS) at least broached the topic. NUCS (1953) suggested that teachers should assess students in by the following questions: Do they appreciate the concept of *number* as a gift? Do they desire to know mathematics and use it for the glory of God? Do they depend on God for wisdom and efficiency in their mathematical studies? These are the recommended assessment questions, but no real help is provided. NUCS (1953) reveals the limitations; "Evaluating this aspect is exceedingly difficult…" (p. 117). Such assessment is necessary, but highly subjective.

Reformed, Christian mathematics teachers. From goals to assessment, a Reformed mathematics curriculum is non-secular and non-humanistic. Yet, Gaebelein (1954) says that teachers "are not immune to secularism" (p. 39). This is especially true of new teachers who have been educated at secular colleges (Gaebelein, 1954). Nickel (1990) points to the same danger as one that is difficult to overcome when he says, "All of us have been raised on a diet of humanistic education. In the Christian classroom, it is extremely hard to break free from this habitual mindset" (p. 108). Nevertheless, Kienel (1978) insists that the key is the teacher, because he or she is the one who is called upon to bring the truth.

Because of the dangers and difficulties, Hoeksema (1935) and Engelsma (1981) urge that Reformed, Christian teachers need to be aware of the tenets of humanism. In the classroom, these teachers should evaluate the humanistic beliefs, contrast these with the Christian perspective, and show themselves to be thoroughly Reformed in their beliefs and pedagogy.

Summary

Research points out two contradictory perspectives of mathematics. Zimmerman (2000) especially outlines the two views; the humanistic one gives mathematicians the credit for inventing mathematics, while the other attributes the honor to God. Both sides witness the universality, usefulness, and utter beauty of mathematics, but only the Christian mathematicians point to these as evidences of a great Creator (Gaebelein, 1954; Zimmerman, 2000).

Regarding the Christian study of mathematics in the classroom, Reformed theologians identify both spiritual and temporal goals. Students are to study mathematics as part of their duty to know God and as occupational preparation (Engelsma, 1971; Hoeksema, 1927). The combination of these goals is distinctly Reformed.

These goals may be accomplished in the classroom with many teaching methods. Lecture, group discussion, modeling, practice, and many other strategies can all be adapted to bring out the Christian perspective of mathematics (Kienel, 1978; Morris, 1977; Nickel, 1990; Steensma & Van Brummelen, 1977; Van Der Kooy, 1925).

For a Reformed, Christian perspective, the Bible must be genuinely central to the study of mathematics (Engelsma, 1971; Hoeksema, 1935). The field of mathematics itself must be studied along with (not above) the other academic fields (Steensma & Van Brummelen, 1977). However, textbooks that sanction this view are vital, but rare (Hoeksema, 1935; Morris, 1977).

As the users of textbooks and the implementers of curriculum, teachers are the ones who make it all happen. In light of the threats of humanism in the field, Christian teachers need to know the tenets of the Christian view of mathematics and apply these for the students (Gaebelein, 1954; Morris, 1977; Nickel, 1990). There are too few teachers who are qualified and aware (Gaebelein, 1954; Hoeksema, 1935; Morris, 1977; Nickel, 1990), and too few suitable textbooks and curricular materials (Hoeksema, 1935; Morris, 1977; Zimmerman, 2000). All this serves to highlight a pressing need. Reformed mathematics teachers need more materials to help convey the Christian perspective of mathematics to students.

CHAPTER THREE – PROJECT DESCRIPTION

Conveying the Christian perspective of mathematics to students is hard to do but essential for a Reformed, Christian school. Especially in his own classroom, this author needs more study and more help in making mathematics education genuinely Christian.

The goals of this project, therefore, are student growth, teacher development, parental awareness, and the glory of God. This project is not about helping students acquire better computational skills; it is aimed at helping them understand the significance of mathematics. For this author, this project has already been profitable. The research study of the previous chapter uncovered some helpful ideas and supplied the substance for a teaching guide for Reformed mathematics teachers. Students of Covenant Christian High School (CCHS) and their parents will be issued course descriptions and syllabi to inform them of the direction of the CCHS mathematics department. These three goals all merge into an overriding fourth—the glory and honor of God, the Creator of mathematics.

This third and final chapter includes a brief description of the project components, several conclusions from the research, and plans for dissemination of the project results.

Project Components

Reformed, Christian teachers stand in the place of the parents and assist them in the duty to rear their children in the fear of the Lord. Therefore, two of the project components are in the form of parent-teacher communications.

The first form of communication is an updated version of course descriptions at CCHS. Last revised for the 1996-1997 school year, the current mathematics course descriptions provide only information about required credits, recommended sequence of courses, and the topics covered by each course. Little in the current course descriptions indicates a Christian, much less a Reformed, view of mathematics. The descriptions seem to treat mathematics as secular.

Since the current ones do not mention the significance of mathematics and the purpose of mathematics education in a Reformed, Christian school, new descriptions have been written for all the mathematics courses collectively and for each course particularly.

The second form of parent-teacher communication is an open letter to parents that can be sent to the homes of parents and students with any regular school mailing. This letter summarizes the Reformed view of mathematics, outlines the goals for mathematics education at CCHS, and urges parents to discuss these ideas with their children.

The largest component of this project is a teacher's guide for this author and other like-minded teachers. Frank Gaebelein (1954) claims that mathematics is the most difficult subject to integrate with a Christian perspective. Gaebelein (1954) and

Zimmerman (2000) both say that too few teachers perform adequately in this respect. This author assesses his own teaching as lacking in this manner. There is a need for a teacher's guide to mathematics instruction at CCHS and at other Reformed, Christian schools.

Consisting of three parts, the teacher's guide includes a variety of useful tools. The first part is an overview of the Reformed perspective of mathematics as it relates to classroom teaching and assessment. The second section is a recommended reading list. The third is a biographical index of notable mathematicians and authors who have contributed to the debate over the philosophy of mathematics.

Conclusions from the Research

There is a great deal of support in this project for the initial claim that expressing the Christian perspective in mathematics is essential, although difficult. Yet, some additional comments must be made.

Regarding perspectives. Given a choice between the humanistic view and the Christian view of mathematics, this author sides whole-heartedly with the Christian perspective. This is not a boast in which this author claims to be superior to others. It is a humble admission that God has opened his eyes to the reality that mathematics is fascinating because the Almighty Designer of the universe created it. Since mathematics is uniquely universal, extraordinarily practical, and stunningly beautiful, the primary goal of mathematics education is to know the God Who made it so.

Regarding pedagogy. The literature review provided some insight into goals and teaching methods of a Reformed perspective. But in spite of their good

intentions, the many authors cited offered precious little advice. The goals are consistent and aligned with Reformed principles of education, but the pedagogical methods are severely neglected. Some paid lip service with a brief reference to some teaching strategies, but no one fully explained *how* to integrate the Christian perspective of mathematics.

Regarding curriculum. Again this author agrees with the bulk of the research. The proper place of the Bible in mathematics education is central. The Scriptural aspect of God's revelation should be the foundation and guide for the study of the mathematical aspect of that same revelation; it is not an artificial accessory. Moreover, if the Bible is central, then mathematics *cannot* be central. Mathematics is not the chief discipline; it is an essential tool for understanding other subjects. Authors of textbooks must recognize this and confirm the proper place of the Bible and the place of mathematics among the academic disciplines. Since most textbooks are strictly secular, new ones must be developed and written. Although many of the associations for Reformed schools such as CCHS are small and financially limited, they should subsidize the development of better textbooks.

Plans for Dissemination and Future Work

Circulation of the project components will begin with a small group and work toward a larger audience. The first step is in this author's classroom. The new course descriptions will be expanded into syllabi for each of his mathematics courses. The teacher's guide will be used extensively to supplement the current textbooks and to assess student understanding.

For wider audiences, the letter "Why Mathematics is in Our Curriculum" will be sent out to all the parents of students at CCHS. The conclusions of the research will be presented to a group of colleagues from the Protestant Reformed Teachers' Institute (PRTI). Finally, the entire project will be sent to the libraries at Calvin College and Dordt College which have been so instrumental in the research process.

Ideas for future work were prompted by two topics introduced in the research. The first was the large number of interesting quotations and anecdotes. This author hopes to write a series of short essays which will highlight these quotations and anecdotes for students, teachers, and parents. Each will take approximately five minutes to read; they may be useful as lesson supplements. The whole collection of essays will be submitted for publication to the PRTI periodical, Perspectives in Covenant Education, and a Christian magazine for young people, The Beacon Lights.

The other recurring topic that prompted the desire for future work is the need for textbooks. More Reformed mathematics textbooks need to be developed, published, and put to use. This author hopes to be a part of this production.

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Appendix A
Course descriptions

MATHEMATICS

(Four semesters of mathematics are required in grades 9-12. All courses are two-semester)

Almighty God designed a universe that includes countless patterns. The universal language of these patterns is mathematics. But so much of mathematics is far beyond our reach. Who can comprehend infinity? Who can comprehend all of mathematics?

Graciously, our sovereign God has led mathematicians throughout history to discover mathematical truths—all connected, all flawless. At CCHS, we study these truths of creation as developed in the notation and work of these men and women. We teach that mathematics is universal. All mathematical truths are the same any time and anywhere. A circle from ancient Greece has the same properties as a circle in Grand Rapids today and so does any circle on any planet in the solar system. The essence of *circle* is universal and unchanging. Mathematics is also useful. A host of other fields rely heavily on mathematics: physics, chemistry, biology, engineering, computer science, etc. Mathematics is also beautiful. The precision, the patterns, and the power of mathematics are sometimes called "beams of God's glory."

This is the Reformed view of mathematics. Therefore, mathematics education at CCHS is also Reformed. Primarily, we study mathematics to show and to know our covenant God and Maker. This implies that mathematics is for everyone—boys *and* girls of high ability *and* low ability. Secondly, a background in mathematics is necessary preparation for a productive life at home and in the workplace. Thirdly, the study of mathematics lends itself well to improvement of academic thinking and writing skills.

Topics in Mathematics

Level: Most basic mathematics course offered at CCHS

Preparation: Recommended for all those who are not going to take geometry

Technology: Calculators sometimes permitted; no graphing calculators; some in-class computer use

Content: Light overview of algebra (functions, logarithms, graphing, etc..), geometry (symmetry, polygons, polyhedra) and probability, statistics, topology, inductive and deductive thinking, permutations, combinations, and the fundamental counting principle.

Geometry

Level: Commonly, the next step after first-year algebra

Preparation: Necessary for any college degree program

Technology: Calculators sometimes permitted; no graphing calculators needed

Content: Inductive and deductive processes, polygons, proofs, constructions, triangle congruency and similarity, right triangles and elementary trigonometry, Pythagorean theorem, area, volume, and circles

Advanced Algebra

Level: Usually taken after Geometry

Preparation: Necessary for any college degree program

Technology: Graphing calculators are required (TI-83 recommended) by the third week; some in-class computer use and TI-CBL activities

Content: The concept of functions, linear functions, quadratic functions, matrices, systems of equations, exponents and exponential functions, logarithms and logarithmic functions, trigonometry ratios and trigonometric functions, polynomial functions, conic sections, and probability

Functions, Statistics, and Trigonometry

Level: Usually taken after Advanced Algebra; may be taken concurrently

Preparation: Valuable for careers in mathematics, science, engineering, or computer technology

Technology: Graphing calculators are required (TI-83 recommended); some in-class computer use

Content: Integrates statistics with the more traditional topics of functions and trigonometry—transformations, descriptive and inferential statistics, elementary combinatorics, probability, and more functions: polynomial, exponential, logarithmic, trigonometric, and circular.

Pre-Calculus/Calculus

Level: Highest mathematics course offered at CCHS

Preparation: Valuable for careers in mathematics, science, engineering, or computer technology

Technology: Graphing calculators are required.

Content: Circular and trigonometric functions, arithmetic and geometric progressions, polynomial functions over complex numbers, matrices, intermediate probability, analytical geometry, limits, derivatives, and integrals.

Appendix B
Letter to parents

Dear parents, grandparents, friends, and supporters of CCHS,

Why Mathematics is in Our Curriculum

The question "Are you good at math?" often gets an extreme answer. Those who label themselves "not good at math" might say, "No! My sister is good at math but I'm not. I hate math. (*Laugh*)." Others who have been given more mathematical ability might be afraid to admit that they are "good at it" because so many people joke about the difficulty of mathematics.

This all-too-common scenario taints our Reformed view of mathematics. Mathematics is for *every*body: young and old, male and female, slow learners and fast learners. Why? *Why do we even teach mathematics at Covenant Christian High School?*

The common answer might be, "Mathematics is for 'smart' students who are 'good at math.'" It helps them work toward high-paying careers that require a background in mathematics." This type of answer reveals a gross misperception.

A better answer is, "Mathematics is *primarily* to help all students come to know our covenant God." Mathematical truths are God's handiwork. These are often used to explain relationships of time, space, and motion—all of which have been part of His Creation since before the Flood. Sir Isaac Newton once said that *through mathematics* we can see:

> "…that the true God…is eternal and infinite, omnipotent and omniscient; that is, his duration reaches from eternity to eternity; his presence from infinity to infinity."

Not everyone agrees. "In mathematics, God's revelation is silent," says Dr. David Neu. In claiming mathematics as a product of human thought and reason, John W. N. Sullivan boasted, "We are the lawgivers of the universe." In a world that

brashly claims mathematics as a product of man's ingenuity and greatness, our students need to know that this is our Father's world. It is fascinating. It is marvelous. It is beautiful. It is His.

In light of this, it is not good to over-emphasize the college-preparatory nature of mathematics instruction. But it is not good to overlook it either. Much of the instruction is geared toward occupations and careers. Graduates of CCHS need mathematics (some more, some less) to be productive at home and in the workplace.

Therefore, the old question "Are you good at math?" is irrelevant. It is not right to hate math. Regardless of ability, every friend-servant in the covenant has an obligation to learn more about our Friend-Sovereign. Please help the students at CCHS to enjoy learning and to "stand still and consider the wondrous works of God" (Job 37:14).

Appendix C

Mathematics

A Reformed Perspective

a guide for teachers

Tom Bergman

Preface

We need help. As Christian mathematics teachers, we need help a) in bringing out the Christian perspective in mathematics instruction and b) in making ours a distinctly Reformed perspective. But before we begin, let me use this preface to state poorly and quickly what this booklet is and is not.

Primarily, this booklet includes an overview of the Reformed view of mathematics. Mathematics is inherently Christian and must be studied that way. Teaching mathematics biblically and covenantally makes it distinctively Reformed. However, this is not a final, exhaustive authority on the subject.

Near the end, you will find a list of recommended books. Although the list is far from complete, you might find some of the references helpful. I recommend that you read two of the books first, although these are not consistently Reformed. These are The Pattern of God's Truth, by Frank Gaebelein, and Truth and the Transcendent, by Larry L. Zimmerman.

After the recommended reading, there is a collection of biographical notes. These are given to acquaint you with some of the people involved in the battle over mathematics education. I hope this can help you in your own studies.

This guide does *not* show you how to make every lesson overflow with Reformed distinctives. Nevertheless, the Reformed perspective of mathematics should be such a foundation for daily instruction that it pervades everything from lesson to homework to assessment.

Pray that God will bless this work. Pray especially that God will guide our colleagues and constituents to fund and develop the writing of our own textbooks.

Overview

In the spiritual war that we wage, there are many distinct battles. The fiercest fighting is usually along the doctrinal front, truth vs. heresy, or on the scientific battlefield, creationism vs. evolutionism. But to assume that these are the *only* two battles is akin to carelessly taking off one's armor. There is very real enmity also in the field of mathematics. Christian teachers need to know the Reformed perspective of mathematics to guard against the dangers of humanism.

The claim that mathematics is secular is rightly called humanism. While Christians attribute the glory of the mathematical universe to the Creator God, humanists deny Him that honor. Instead, they credit the genius and reason of the human mind.

Humanists assert that mathematicians invent mathematics. In 1980, Morris Kline boldly defined his position:

> "…Nature's laws are man's creation. We, not God, are the lawgivers of the universe. A law of nature is man's description, not God's prescription." [1]

The Christian author Larry L. Zimmerman cites a similar statement by John W. N. Sullivan who said:

> "We are the lawgivers of the universe; it is even possible that we can experience nothing but what we have created, and that the greatest of our mathematical creations is the universe itself." [2]

Their claim is that a Christian perspective of mathematics does not exist. In 1976, Dr. David Neu expressed this sentiment:

> "Integration is not possible in mathematics. In mathematics, God's revelation is silent. There is nothing to integrate." [3]

This is raw humanism.

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[1] Kline, Morris (1980). Mathematics: The Loss of Certainty, p. 97
[2] as cited in Zimmerman, Larry L. (2000). Truth and the Transcendent, p. 24
[3] as cited in Zimmerman, Larry L. (2000). Truth and the Transcendent, p. 1

These men are brilliant mathematicians. They see how the marvels of the physical world are delicately intertwined with mathematics. But they are at a loss to explain how man has been able to invent a body of mathematical truths that is complex but never contradictory, and abstract but always applicable. Perhaps Albert Einstein said it most clearly:

> "How can it be that mathematics being after all a product of human thought… is so admirably appropriate to the objects of reality?" [4]

Using the pseudonym Nicolas Bourbaki, a group of French mathematicians seems equally perplexed:

> "…There is an intimate connection between experimental phenomena and mathematical structures [which] seems to be fully confirmed in the most unexpected manner…. But we are completely ignorant as to the underlying reasons for this fact." [5]

Also, Nobel Prize winner Eugene Wigner writes openly of his own confusion:

> "It is hard to believe that our reasoning power was brought, by Darwin's process of natural selection, to the perfection it seems to possess." [6]

These humanists fall under the description: "Ever learning, and never able to come to the knowledge of the truth" (II Timothy 3:7).

As confessing Christians, the mathematics teachers in Reformed, Christian schools find the humanists' position repulsive and shocking. The danger is not that a Christian will teach this. The danger is when little is done to counter it.

The situation calls for awareness and knowledge of the Reformed view of mathematics. The Reformed, Christian view of mathematics begins and ends with God the Creator. Roughly six thousand years ago, God created heaven and earth in six twenty-four hour days. Speaking of God the Son, the Apostle Paul wrote:

> "For by him were all things created, that are in heaven, and that are in earth, visible and invisible, whether they be thrones, or dominions, or principalities, or powers: all things were created by him, and for him. And he is before all things, and by him all things consist" (Col. 1: 16, 17)

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[4] as cited in Zimmerman, Larry L. (2000). Truth and the Transcendent, p. 35
[5] as cited in Zimmerman, Larry L. (2000). Truth and the Transcendent, p. 27
[6] as cited in Zimmerman, Larry L. (2000). Truth and the Transcendent, p. 6

Since mathematics is a servant to time, motion, and space, it is part of God's good Creation. Mathematics is intricately linked to the physical world. Although God judged the world and destroyed it along with all the inhabitants save those in the ark, mathematical truths are still part of Creation.

Such truths are not merely present in Creation. They clearly testify of God's power and greatness. The Belgic Confession states that God is made known to us

> "by the creation, preservation and government of the universe; which is before our eyes as a most elegant book, wherein all creatures great and small, are as so many characters leading us to contemplate the invisible things of God…. Secondly, he makes himself more clearly and fully known to us by his holy and divine Word…" (from article 2)

Holy Scripture is the primary way that God reveals Himself. However, the universe is another "elegant book" which makes us "contemplate the invisible things of God." The mathematical universe is to be studied in the light of God's Word.

This principle is a distinctive feature of Reformed education. God's Word and God's Creation are two aspects of the same revelation. They are not separate, autonomous, or independent of each other. It is important to remember that "the worlds were framed by the word of God" (Heb. 11:3).

Reformed distinctive:
God's mathematical universe is not separate from God's Word. These are two aspects of a single, unified revelation. Mathematics should be studied in light of Holy Scripture.

Many in the church world have separated the two. Prof. Hanko explains how Kuyperian ideas led to the notion that Creation is a separate, more general revelation:

> According to Abraham Kuyper, common grace is the basis of the Calvinistic worldview…. First, it restrains sin in the ungodly, so that they are not totally depraved. Secondly, it enables the ungodly to see and approve the truth made known by general revelation and to do what is good and right in natural life. Thus, they can develop the creation positively…. And third, common grace permits Christians, indeed *calls* them, to join hearts and hands with the ungodly in this positive development of culture. [7]

Others who take this view elevate the word of men who were not eyewitnesses of the Creation week over the Word of the Creator God who was there. Supposing that

Creation is separate from the Bible, they place tremendous faith in the assumptions and theories of humanistic scientists who say that the origin of the world was far different than the Creation accounts in the Word of God. This is tantamount to studying Scripture in the light of "scientific" speculation.

One should not forget that God is also revealed through His sustaining work which we see every day. Mathematics is the alphabet of the "elegant book" which describes the numerical, physical, and spatial relationships *which He governs each day*. The study of everyday patterns and relationships prompts saints to sing, "Great and marvelous are thy works, Lord God Almighty" (Rev. 15:3).

The Reformed view of mathematics fits beautifully with the Reformed view of covenant education. Mathematics education in Reformed, Christian schools has covenantal goals. The main goal is spiritual in nature; the other two are earthly.

The primary goal is to help students come to a better knowledge of God, the Author of the covenant. Jehovah chose His people in eternity, established His covenant with them, and saved them from destruction through the sacrifice of His only begotten Son. He is their God—their Friend-Sovereign. Thus it is the desire and duty of the friend-servants to know Jehovah and commune with Him. Since the mathematical Creation is His handiwork, the study of mathematics is intended to help students come to a better knowledge and fellowship with God. Learning about God's perfect wisdom, power, infinity, and immutability through His mathematical universe is truly an end in itself. Moreover, it is a distinctive feature of mathematics education in Reformed, Christian schools.

Reformed distinctive:
The primary goal of the study of mathematics is covenantal—that friend-servants in the covenant may come to a better knowledge and appreciation of Jehovah's perfect wisdom and beauty.

There is an element of this spiritual goal that deserves special mention. True knowledge of God leads one to *appreciate* and *enjoy* the characteristics of

[7] Engelsma, Prof. D. (1998). "The Reformed Worldview." The Standard Bearer. May 15, '98. p. 366

mathematics. Larry L. Zimmerman identifies three major characteristics: universality, usefulness, and beauty.

That mathematics is a universal language is evident in several ways. Mathematical concepts are universal over time and distance. For example, ideas related to *existence of number* and *equality* are not subject to change. Their meanings are the same in times past, present, and future. Their meanings are the same in nearby lands and far-off places. Their meanings are the same for enormous galaxies as they are for tiny molecules.

Mathematics is also universal within itself. All mathematical discoveries intermesh with all other mathematical discoveries past and present. Not only are there are no contradictions, but also the various subjects within the field of mathematics, such as algebra and geometry, support each other perfectly.

Finally, there are unifying elements within mathematics that give it a universal quality. Although these include sets and function, the best examples are perhaps the real constants π and e. Although π is the ratio of circumference to diameter of any circle and e is usually associated with continuous exponential relationships, both values pop up rather unexpectedly in a host of other places. With the eyes of faith, one seeking to know God can appreciate the universal characteristic of mathematics.

The second characteristic highlighted by Zimmerman is the usefulness of mathematics. Mathematics is not an abstract body of truth that is mutually exclusive from the rest of the world. God has intricately woven the patterns of the physical world into mathematical relationships. Therefore, it is no surprise to find that mathematics has many applications. Evidence of the usefulness of mathematics is readily apparent in science and industry.

Thirdly, Zimmerman points to the beauty of mathematics.

> It is true that the melody of nature's song can be enjoyed without knowledge of its underlying mathematical structure. If you are privileged to view to creation through a microscope or telescope, to hear the sound of wind or thunder, to hold a baby duck or a baby person, you come to appreciate the beauty and power in nature whether you are acquainted with the "Mean Value Theorem" or not. But the lyric of "the music of the spheres" is clearly

> mathematics, a knowledge of which unveils not only vistas of beauty and power unsuspected before, but also an order, symmetry, and infinitude which stuns and awes the beholder.
>
> Beauty, power, order, symmetry, infinitude—though these characteristics of mathematics are there for anyone, the Christian sees them in their proper light as reflections of God's attributes…. They are beholding beams of God's glory. [8]

God's covenant children should be trained to study God's beauty, marvel at His glory, and attribute the honor to His Name.

The other reasons for teaching mathematics in Reformed schools pertain to earthly matters. The secondary goal is to enable these students to take up occupations while pilgrims in this world. Many will be given families to raise and support. To do this, a background in mathematics is becoming more and more necessary for life at home and in the workplace.

The tertiary goal of Reformed, Christian mathematics education involves three potential areas of academic growth. The study of mathematics promotes and develops thinking skills. Communication in mathematics requires emphasis on accuracy and neatness. Full understanding of mathematics demands cross-disciplinary application and evaluation.

The hard work comes after these lofty goals have been put into practice in the classroom. It is very difficult to assess students in this area. Nevertheless, the Reformed view of mathematics must be taught and what is taught must be assessed.

Either formally or informally, teachers in Reformed, Christian schools must find out if the students understand and appreciate the significance of mathematics. Although it is difficult to gauge spiritual matters of the heart, some amount of questioning has to take place. Names and details regarding the historical fight between humanistic mathematicians and Christians can be fashioned into objective test questions such as multiple choice or fill-in-the-blank. More importantly, longer responses in written form should be used to assess the students' comprehension of

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[8] Zimmerman, Larry L. (2000). Truth and the Transcendent, p. 55.

abstract ideas: attributes of God, covenantal goals, origin and nature of mathematics, and mathematical concepts that point to the Almighty Designer.

Where this kind of assessment guides classroom instruction, those classrooms and schools are actively engaged in the battle. Since mathematics is not directly related to matters of salvation and grace, this battle is not the biggest battle in our spiritual; nevertheless, it is raging hot. Its soldiers are the Christians and humanists who are fighting on the flank of the science battle where "scientific scabbards fall away to reveal ideological swords." [9] The outlook seems bitter at the moment; humanism apparently prevails in this war of ideas. Yet the victory is in the Lord Jesus Christ because He ascended into heaven and "every thought" is brought into captivity "to the obedience of Christ" (II Cor. 10:5).

[9] Schlossberg, H. as cited in Nickel, J. Mathematics: Is God Silent? p. 70.

Recommended Reading

Mathematics and education—Christian perspective

Gaebelein, Frank E. (1954). The Pattern of God's Truth: Problems of Integration in Christian Education. Available at Calvin College Hekman Library and Dordt College library.

Morris, Dr. Henry M. (1977). Education for the Real World.

Niblett, W. R. (1960). Christian Education in a Secular Society.

Nickel, James (1990). Mathematics: Is God Silent?

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Van Brummelen, Harro. (1988). Walking with GOD in the Classroom.

Zimmerman, Larry L. (2000). Truth and the Transcendent: The Origin, Nature and Purpose of Mathematics. Answers in Genesis, P.O. Box 6330, Florence, KY 41022.

Mathematics—humanistic perspective

Bell, Eric T. (1937). Men of Mathematics.

Hardy, Godfrey H. (1941). A Mathematician's Apology.

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Christian education—history

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