

Integration of Faith and Mathematics

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1 Introduction

Most Cedarville students take a mathematics course during their undergraduate experience. As of Fall 2014, only 1.4 percent of Cedarville undergraduate students are mathematics or mathematics education majors (Carraher (2014)). A significant number of students in Cedarville math courses, especially Intro to Math, Pre-calculus, and Calculus 1, are required to take the class even though they may not currently enjoy math or feel that it is not relevant to their major. Some of these complaints may stem from bad experiences in math courses in the past, in high school or even earlier, along with a misconception that math is just a list of equations and confusing methods to memorize. Furthermore, many students do not appreciate the beauty of math and its relationship to our Christian worldview, making it less appealing to study.

In this paper, I want to explain some highlights of my Christian worldview, how it interacts with mathematics, my commitment to Christian higher education, and how these beliefs lead to a respect for students as bearers of God's image, and the means and methods by which I specifically encourage students to grow in their beliefs and strive to promote active learning in class. Section 2 contains a description of a Christian worldview, specifically related to creation, the relationship between God and man, and epistemology. In Section 3, I discuss how a Biblical worldview interacts with mathematics, and specifically what in

mathematics is rejected, affirmed, and redeemable by a Christian worldview.

Section 4 considers the topics of Christian higher education in general and students as image-bearers. Since each student is created in the image of God, I am committed to showing each student care and respect as each one works to understand challenging concepts and methods. Many Christian students often have not considered how math and math classes are inherently relevant to their Christian life. My desire is that students come to appreciate the value of mathematics even apart from specific applications. I want students to see the beauty of mathematics and how it reflects God's design in the world more fully.

Because of how many students may believe math classes are boring, too difficult, or irrelevant to their Christian life, I want to help each student actively enjoy my math classes, to encourage them to learn in their own style and pace, and assist their understanding of the relationship between math and our Christian worldview. These are some important ways that I believe my Christian worldview can be integrated into my discipline and the math classroom.

2 Creation and Epistemology

In order to integrate faith with learning, Cedarville faculty members must have a clear understanding of our worldview, including the topics of creation, man, and epistemology. First, God created the universe in six 24-hour days. As Davis (2012) from *Answers in Genesis* explains, Jesus read the text of the Old Testament as literal history, which is the most natural and traditional way to read the text. God did not utilize any form of evolution or the Big Bang in order to bring about the world and mankind.

Also, the Bible is clear that God purposefully created humans in his own image (Genesis 1:27). Since man was made in God's image, we are loved and of primary importance to him, which is a great blessing and is beyond our comprehension.

Because God created the world in his own design and by his choice, all knowledge comes

from God, including knowledge about mathematics and about teaching. Daniel 1:17 (NIV) says, “To these four young men God gave knowledge and understanding of all kinds of literature and learning. And Daniel could understand visions and dreams of all kinds.” As God gave understanding to Daniel, Shadrach, Meshach, and Abednego, God is the source of knowledge. Still, he gave special understanding to Daniel, such as the ability to interpret dreams, that most of us will never be given.

God has revealed truth to mankind through Special Revelation, through Jesus Christ and the Bible. Colossians 2:3 says that in Christ “are hidden all the treasures of wisdom and knowledge.” Jesus also said “I am the way and the truth and the life” (John 14:6). Thus, even knowledge about mathematics comes back to Christ, who knows all and give us understanding. In Psalms, David says, “I gain understanding from your precepts,” so truth is found in the pages of scripture. In particular, science is not the final authority of truth for Christians, but rather the Bible is the final authority, which is discussed more in Section 3.

In addition, not all of God’s truth is written in the pages of the Bible. God shows people about himself through nature and all of creation through General Revelation. Creation clearly shows truths about God (Psalm 19:1-4, for example), but it does not reveal everything about him. We know that God’s ways are different from our ways, and that many things about him will be revealed in Heaven.

God’s truth gives us a reason to study math and any discipline. The reality that God created the world forms our view for how we face our discipline and gives us the goal of learning more about God through his creation. Even God’s command to be a good steward of his creation leads us to study math to better care for that which God has entrusted to us. As stated by Pearcey and Thaxton (1994), “Dominion was understood not as license to exploit nature ruthlessly but as responsibility to cultivate it, care for it, and harness its forces for human benefit.” Studying creation and thus mathematics I believe honors God.

3 Mathematics and the Christian Worldview

According to Hasker (1992), faith-based integration is “a scholarly project whose goal is to ascertain and to develop integral relationships which exists between the Christian faith and human knowledge, particularly as expressed in the various academic disciplines.” We have discussed briefly how scripture and scriptural principles relate to mathematics. In particular, how are the truths believed by mathematicians affirmed, rejected, or redeemable by a Biblical worldview?

3.1 Absolute Truth and Development of Modern Science

In mathematics, the idea of absolute truth is important. To study mathematics, a person must accept the absolute truth of certain axioms, such as completeness of the real numbers. Mathematicians have confidence that there is a certain amount of order in mathematics. If that were not so, for example, sometimes all relative extrema of a continuous function $f(x)$ in an open interval would occur where $f'(x)$ is zero or undefined, but other times they could occur at other points.

This belief that truth is not relative is also a requirement for a Christian worldview. As Christians, we believe in absolute truth, that God’s Word is always true, and that God does not change. He is the same yesterday, today, and tomorrow.

Since all truth is God’s truth, mathematics belongs to God. I believe that math shows God’s design. God reveals himself in what we see, such as through nature, and thus, he specifically reveals himself through the study of mathematics. It shows his intentionality, his order in creation, and even his beauty. God set up an order in the world that he will not change. He will not decide that Jesus’ blood no longer saves people.

Pearcey and Thaxton (1994) explain that the fact that most of Europe had underlying Christian beliefs at one time contributed significantly to the development of modern science and mathematics. It provided the necessary beliefs for their study and development. First,

the Bible shows that nature is real, not a figment of people's imagination. Thus, it can be studied and truths about it can be discovered.

Also, the Bible says that nature has value and God said that his creation was good. He created it intentionally and told Adam and Eve to take care of it. In addition, in order to have a reason to study the world, people must believe that it behaves in a predictable fashion, which is also a truth of a Christian worldview. Derr (1973) said, "Nature was thus abruptly desacralized, stripped of many of its arbitrary, unpredictable, and doubtless terrifying aspects." Also, Collingwood (1940) said, "The possibility of an applied mathematics is an expression, in terms of natural science, of the Christian belief that nature is the creation of an omnipotent God."

Furthermore, because humans are in the image of God, they have the rationality to be able to study and understand God's order in creation (Pearcey and Thaxton (1994)). Thus, it is important to keep in mind that originally there was no perceived discrepancy between Christianity and science, but rather that the two go hand in hand and support one another.

Since mathematics shows God's order in creation and more about himself, learning is not only an academic endeavor but a spiritual one too. In relation to integration of faith and learning, Bahnsen (1996) says, "...God's word demands unreserved allegiance to God and His truth in all our thought and scholarly endeavors." Helping students understand God's truth is primary to our calling as faculty at a Christ-centered institution.

3.2 God's existence

Not only does math illustrate God's beauty, order, and design, mathematics supports God's existence. In the essay *The Unreasonable Effectiveness of Mathematics in the Natural Sciences*, Wigner (1979) says that the "enormous usefulness of mathematics in the natural sciences is something bordering on the mysterious." Windheuser (2015) says, "Others have noted how very effective very simple mathematics and geometry have been in describing many significant aspects of nature, and asked the questions 'Why should it be so?' Why

should it be that the universe can be so well-described by humans in mathematical terms when the universe itself is said to have begun in chaos and proceeded in random fashion without having human beings in mind?... Based on this, rather than randomness, one could reasonably suspect a conspiracy of reason behind it all.” The author also says that many scientists and mathematicians in the past, such as Galileo, Kepler, and Newton, came to this same conclusion. They “recognized that the effectiveness of mathematics was the result of a conspiracy of One... He is the mind behind the design...” Some examples the author cites are population biology, modeling of gene frequencies, the laws of physics, and the Pythagorean Theorem.

As described in the book by Casti and Karlqvist (1999), John Barrow notes how “impressively mathematics works.” He mentions that with elementary particles and even outer space, predictions based on mathematics are “almost unreasonably accurate...” Many physicists have come to the conclusion that the idea that math is a human creation is a very poor explanation for how well it describes our world.

As Pearcey and Thaxton (1994) explain, not everyone agreed with Isaac Newton’s belief in gravity. He viewed it as a way that God actively works in his creation, and “gravity thus served an apologetical purpose for Newton,” and was evidence to him of God’s participation in the world. Another piece of evidence Newton believed supported God’s existence and role with humans was the delicate structure of the solar system. He said, “This most beautiful system of sun, planets, and comets could only proceed from the counsel and dominion of an intelligent and powerful Being” (Newton (1713)).

Along these lines, Tuinstra (2012) says that, “not only why mathematics works, but why can it be applied so successfully to problems that engineers are so eager to solve?... These are the questions that unbelievers are not eager to answer because their materialistic worldview is not able to account for the order and logic that is present in the universe.” He cites examples such as the constants e and π , and how “Maxwell’s equations predict so accurately all electromagnetic phenomena in the universe that we know of.”

Stewart (2007) says that people do not need to believe in God to notice the patterns in the world and to see that they are mathematical. I disagree and would argue that these give strong evidence for the existence of a creator God. There is no way to explain how well mathematics fits with the physical world unless there is a logical God who created it all.

3.3 “God is a Mathematician”

This is a prideful statement for a mathematician to make, but Paul Erdos believed that God has a book that holds the best proofs ever written (Stewart (2007)). If Erdos particularly liked a certain proof, he would say that it was contained in “The Book.” “In his view, the mathematicians’ job was to sneak a look over God’s shoulder and pass on the beauty of His creation to the rest of His creatures.”

These are not the only statements made by prominent mathematicians of the past about God’s relationship with mathematics. In the 4th century BCE, Plato said that God is a geometer. Later, in 1939, Paul Dirac declared that “God is a mathematician” (Stewart (2007)).

Math allows people to see God’s beauty in a way nothing else could ever do. We can see God’s design in the beauty of a succinct mathematical proof and in an equation that nicely describes a phenomenon of nature. For example, the derivative of velocity is acceleration, and Bayes’ Theorem allows us to calculate useful probabilities that describe the world. “There is an aesthetic of proof, so that a really good story can be a thing of beauty” (Stewart (2007)).

Studying math even makes us aware of God’s creation in new ways. As Stewart (2007) says, “It opens my eyes to nature’s laws and patterns. It offers an entirely new experience of beauty...The rainbow is just one example...When I look at a crystal, I am aware of the beauties of its atomic lattice as well as the charm of its colors.” The author also says that “Then there’s the inner beauty of mathematics, which should not be underrated. Math done ‘for its own sake’ can be exquisitely beautiful and elegant.”

3.4 Contradictions and Redeemable Ideas

What does a Biblical worldview reject in mathematics? According to Pearcey and Thaxton (1994), mathematics was an idol for many people at the end of the 1700's. People believed that the world was so perfectly explained by mathematical discoveries that there was basically no need for God except in initially creating it. Human reason was depended upon to reach absolute truth and no dependence on God was deemed necessary. Natural law, which was believed to be a direct result of mathematics, made divine work such as miracles to be considered impossible. People thus concluded that the Bible was false. Eventually this led to many mathematicians believing that there is no absolute truth and to strive instead only for consistency within mathematics.

The philosopher David Hume (1711-1776) proposed that the human mind cannot actually know causality, but that people only notice two events and assume they have a cause and effect relationship. An example is the relationship between fire and heat (Pearcey and Thaxton (1994)). The causality may not be true in the real world. In response to this, Kant's explanation of why mathematics explains the world so well is that even though perceptions do not necessarily represent the natural world, "mathematical laws are not true in the old sense - i.e., rooted in the nature of reality - since we cannot know reality. Instead they are rooted in the human mind. But since the human mind has an inherent structure that is everywhere and always the same, mathematical laws are universal and necessary" (Pearcey and Thaxton (1994)).

All of these ideas are ones that a Christian worldview rejects. Mathematics should never be considered above or equal to God, and our world cannot continue without him allowing it to persevere. Also, the Bible tells us certain truths about reality that we believe, and these truths are not figments of our minds. We believe that absolute truth is shown to us through General and Special Revelation, and that truth is not relative. The Bible shows an order in the world and can be discovered with mathematics. Mathematics is not independent of God though. Christianity gives mathematics its proper respect and place in God's creation

(Pearcey and Thaxton (1994)).

In a more specific way, some mathematics applications have decisions that could be contrary to a Biblical worldview. For example, statistics are often used to distort the truth for selfish purposes. Deception like this is clearly in discord with the Bible. Another example is dating methods, which use mathematical ideas, and through faulty logic, often result in an age of the earth that is contrary to the Bible's teachings. These two topics are redeemable, in that Christians can choose to be ethical in their use of statistics, and a greater understanding of accurate dating methods can be taught.

4 Math Pedagogy and the Christian Worldview

4.1 Christian Higher Education

For my undergraduate education, I attended Cedarville University. I benefited greatly from the professors' care of each student, and their pursuit of excellence in their fields of study as well as their teaching. My professors often had an open door policy, encouraging students to come to their offices any time during the day. In addition, I enjoyed attending chapel, having prayer before many classes, and participating in spiritual formation activities and ministries. The influence of the faculty and other students helped me to grow spiritually at Cedarville.

My experiences at both Cedarville University and the University of Michigan for graduate school have developed my commitment to Christian higher education. First, I feel that it is important to strive for excellence in my field of mathematics and in teaching, as those are important at any school. My goal is to be dedicated to each student personally in order to help all of them prepare for careers where they effectively serve Christ, demonstrate excellence in their fields, and share Christ with others.

I am in agreement with Cedarville's mission of being a "Christ-centered learning community equipping students for lifelong leadership and service through an education marked

by excellence and grounded in biblical truth.” In particular, mathematics helps students to think more broadly and deeply and to communicate effectively, as mathematics helps students have attention to detail and to provide logical reasons behind statements and beliefs.

The Reformation encouraged people to serve God in whatever field they worked or served, whether it was consider secular or Christian (Pearcey and Thaxton (1994)). Serving God and following his call to be a mathematician are not contradictory. The secular work of teaching mathematics (even at a Christian institution) is a vocation to which I believe God has called me. It is service to the Lord, even though I do not directly share the gospel with my students every day. Johannes Kepler’s notebook contains this prayer: “I give you thanks, Creator and God, that you have given me this joy in the creation, and rejoice in the works of your hands. See I have now completed the work to which I was called. In it I have used all the talents you have lent to my spirit” (Pearcey and Thaxton (1994)). Calvin said, “there is need of art and more exacting toil in order to investigate the motion of the stars, to determine their assigned stations, to measure their intervals, to note their properties” (Cited in Klaaren (1977)). Along these lines, teaching mathematics is an act of service to the Lord.

4.2 Students as Image-Bearers

I want to discuss the goals and objectives for communicating these beliefs about God and mathematics in the classroom. More important to me is to discuss the means and methods of integrating these beliefs of faith and learning.

God purposefully created humans in his image with the ability to connect with him. He loves us greatly and being in his image is integral to our relationship with him. Every student is dearly loved by God enough to sacrifice his Son (John 3:16), and was purposefully created in a certain way (Psalm 139). Our dignity comes directly from God, not from any work, action, or understanding that we have. Many, many verses from scripture support each person’s worth and individuality in God’s eyes. Several are listed below.

- Genesis 1:27 - “So God created mankind in his own image, in the image of God he created them; male and female he created them.”
- Psalms 8:3-5 - “When I consider your heavens, the work of your fingers, the moon and stars, which you have set in place, what is mankind that you are mindful of them, human beings that you care for them? You have made them a little lower than the angels and crowned them with glory and honor.”
- Psalms 139: 13-14a - “For you created my inmost being; you knit me together in my mother’s womb. I praise you because I am fearfully and wonderfully made;”
- Matthew 7:12 - “So in everything, do to others what you would have them do to you, for this sums up the Law and the Prophets.”
- 1 John 4:9 - “This is how God showed his love among us: He sent his one and only Son into the world that we might live through him.”
- 1 Corinthians 3:16 - “Don’t you know that you yourselves are God’s temple and that God’s Spirit dwells in your midst?”

Each of my students is in the image of God and is important to him and to me. Each student is greatly valued, as illustrated in the verses above. “The Christian affirmation of human personhood goes... to a philosophical and theological honoring of human beings made in the image and likeness of a Creator-God” (Sullivan (2008)). According to Sullivan (2003), “Naturalism has led to a devaluation of human beings, who no longer have inherent dignity and worth... postmodernism has promoted the idea that meaning and purpose are illusory goals not even worth pursuing. The Christian’s worldview offers a startling contrast, with a view of human beings made in God’s own image, the highest achievement of God’s creative impulse. Such a view gives us worth, dignity, and hope.”

Because of this, I believe it is important to treat each student with respect and love in the classroom and during office hours. Since each student is an image-bearer, each student

deserves patience, especially when he or she has trouble understanding a topic. As part of this, students need to know that they are never alone in their learning journey when they initially do not understand a concept or example and that others and I have time to help them. I try to encourage students to ask questions during class and to come to my office to understand our topics more fully. In particular, each person is uniquely gifted by God (Romans 12:4), and thus also has specific learning styles and classroom instruction methods that work best for him or her. I want each student to know that their understanding is important to me, and to keep everyone involved in class.

Part of this involves active learning in the classroom. In my classes, I like to include short activities in class, have students try problems on their own or with those around them, and encourage students to present their results on the board sometimes. Many students learn by explaining, or are more auditory or visual learners. I try to include graphs, written-out statements, and hands-on activities when possible. As much as possible, I want class to be enjoyable and interesting, with examples that are clearly relevant to various majors, and to share my enthusiasm for the topics we study.

Next, I would like to discuss some specific examples of how I try to exemplify these ideas in my interactions with students, from teaching them specific topics related to our Christian worldview, to how I interact with students, including respecting their individuality by encouraging their involvement in class and incorporating different learning styles. First, there are a couple examples of students learning about a Christian worldview directly.

- In Calculus 1 class last semester, students completed a lab on exponential growth and decay models. One example in particular had students calculate the age of an object using carbon dating methods. After that example, they read that this is not a reliable method for dating objects, partly because of the assumption that carbon has always decayed at the same rate. Students concluded that carbon dating, which often estimates a very high age of the earth, is not reliable.
- In Research Methods in Math last year, students read the book “God At Work”

(Veith Jr (2011)). One of the main concepts in this book is that there is no divide between secular and Christian work. In whatever work God calls a person, he or she can serve him through the way they do that work. The students enjoyed this topic and found it quite encouraging as they considered careers such as being professors, actuaries, etc.

The next few examples illustrate respecting students as image-bearers, and also encouraging their active learning in class in order to incorporate their various learning styles and help them have a greater appreciation for mathematics.

- In Calculus 1 last semester, one of my students dealt with seizures. Because of this, he needed extra help and explanation much of the time. This was an opportunity for me to show God's love to him in being patient and helping him through the semester.
- To discuss the disk method for finding volumes of solids of revolution in Calculus 1, the students completed an activity where they made a long, thin rectangle with a piece of paper and revolved it around another student's arm (pretending it is one-dimensional) and wrote an equation for the volume of the solid swept out.
- Last semester, the Calculus 1 students also presented in groups the history of topics we were discussing in class, such as the history of related rates or Newton's influence in Calculus.
- In Intro to Biostatistics last year, I used the website Poll Everywhere to create short surveys for students to complete for a problem's answer in class to check their understanding and to encourage their active learning.
- It is helpful to use real-world examples to pique students' interest. The following are a few examples.
 - In the course evaluations for Biostatistics, one student wrote, "I really appreciate

the real life examples. This helped me remember each chapter's material because I know why the information mattered."

- Helping students see the usefulness of mathematics to real life often encourages them to learn more as well. In Intro to Operations Research last year, one student commented in the course evaluations, "The strength of the course is that it is very applicable to real life."
- This semester in my Capstone class, we had been discussing the Fleet Assignment Model for airline scheduling, its characteristics, and what is challenging about this problem. The students were so excited to see the mathematical model that they did not want to end class and wait until the next class period.

5 Conclusions and Future Research

As I gain more experience as a mathematics faculty member at Cedarville, I look forward to studying the concept of integration of faith and learning more. In this paper, I have tried to demonstrate my beliefs so far about how mathematics can be integrated with a Christian worldview.

In particular, since God was the creator of the world, all truth comes from him, and studying mathematics helps us to understand God better and appreciate his creation. Mathematics also supports the existence of God and reflects his beauty. Treating students as image-bearers and catering to different learning styles are practical ways integration can play out in everyday life in the classroom. As Stewart (2007) says, "Teaching matters...It is your opportunity to pass on your understanding of math to the next generation," to which I would add that it is also our opportunity to share our understanding about our creator and the relationship between him and our discipline, and to show students their value as God's special creation.

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