Integrating Moral and Spiritual Themes in Middle School and High School Mathematics Teaching Units

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Introduction

This paper provides an update for a project first described at the 2005 ACMS Biennial Meeting [4]. During the past two years, a total of nine lesson units have been developed, tested in mathematics classroom at a variety of grade levels, and revised into a final collection that was recently published [2]. The following paragraphs provide a brief overview of the project (see [4] for further detail), results from classroom testing during the past two years, and a description of recent and upcoming initiatives designed to disseminate these teaching materials as widely as possible.

Purposes and development of math lesson units

In 2004, a team of five people, including two high school mathematics teachers and three college faculty members in mathematics and mathematics education, held a series of meetings to discuss the feasibility of developing a series of mathematics lessons that integrate elements of a Christian perspective in meaningful ways. The work on this project was funded by a grant from the Kuyers Institute. Initially, the group examined materials recently published by the Charis Project in Great Britain [6].

As the discussions continued, a number of issues surfaced. First, analysis of the materials from the Charis Project showed a large proportion of lessons focusing on data analysis and inferential statistics. While this topic is relevant in the high school curriculum in the United States, the writing team identified the need to provide more lessons connected to the other content areas recommended by the National Council of Teachers of Mathematics [5], especially algebra and geometry. Second, the writing team decided that links to a Christian perspective should be significant rather than superficial additions of at most tangentially related Bible verses. In particular, some attention needed to be given to the nature of mathematics itself and important implications for the mathematics studied in modern times in light of the historical and philosophical roots of the discipline [3]. Finally, to ensure maximum possible distribution of these classroom materials, particularly in international school settings with limited funds for teaching materials, the team agreed that all materials developed as part of the project would be made available without charge to all interested teachers. In fact, rather than paper format, these materials would be placed on a website in an effort to minimize production costs and maximize potential use of the materials at schools around the world.
A brainstorming session yielded nearly twenty potential themes for the mathematics lessons. After reviewing the list to minimize content overlaps and maximize links to algebra and geometry, each member of the writing team agreed to develop two lesson units. Importantly, it was agreed that each lesson unit could be composed of individual tasks, and that the collection of these tasks might take several classes to complete. With regard to the integration of a Christian perspective, the writing team chose to identify one or more spiritual or moral themes that would connect to each lesson unit, and these themes would be listed at the beginning of the teacher materials along with the mathematical concepts addressed in the lesson unit. Although each writer chose appropriate ways to integrate the spiritual and moral themes, the general pattern included introductory remarks, periodic references during the different tasks, and summative reflection exercises at the end of the unit.

During the following twelve months, a total of nine lesson units were developed (see the weblink in [2] for a complete list of topics). After some initial testing in classrooms taught by members of the writing team, these lesson units were edited and revised. At each stage of the development process, each member of the writing team was encouraged to provide feedback to the rest of the team.

Classroom testing of lesson units

During the 2005-2006 and 2006-2007 academic years, all of the lesson units were tested in middle school, high school, and college classroom at schools within the United States and around the world. With one exception, the schools piloting the lesson units were Christian schools. This made the use of the spiritual and moral integrative themes a bit more natural than in public school environments. Each teacher who piloted one or more of the lesson units found them to be valuable additions to the topics already being addressed in the mathematics classrooms. In several cases, specific feedback was returned to the writing team, resulting in revisions in the final versions that are now available online [2]. The following paragraphs provide several brief vignettes that illustrate how these materials can be used successfully at various grade levels.

At the middle school level, Patrick Eggleton of Huntington University used the first unit ("Why should we study math?") with his sixth and seventh grades students at the Numonohi Christian Academy in Papua New Guinea. He adapted the exercise involving numerous quotations about mathematics into a matching exercise, but he left the related scriptural passages more open ended. Patrick commented that "most of my students found the information valuable." He analyzed the results of using the lesson unit and noted that "students seemed to sum up their observations by saying that we should study math because it is part of how God created things. We should know as much as we can about God’s creation." Patrick viewed these results favorably, and he hopes to use more of the lesson units in the coming year as he teaches senior high school students at the same school.

At the high school level, Sean Bird of Covenant Christian High School piloted nearly every lesson unit with his Advanced Placement Calculus students. In this case, the materials provided an interesting set of supplementary lessons that students enjoyed completing during the weeks following the AP Exam in May. In particular, students liked lesson units that were situated in applications of mathematics to their everyday lives. One example was the fourth unit which
covers exponential functions. Many of these students had not previously thought seriously about the value of saving for retirement, even the need to begin such plans immediately after college. Other sections of this lesson unit highlight the growth of human population, the impact of humans on our environment, and the potential impact of recycling programs and other ways to the amount of garbage in landfills around the world. Overall, Sean reported that his students enjoyed learning, and in many cases relearning or extending, a variety of mathematical concepts within a context of both real world applications and an ongoing discussion of related moral and spiritual issues.

Andrew Busch used the eighth lesson unit ("The gender gap") with his students taking statistics at Fremont High School, a public high school in Michigan. Andrew designed this unit to replace corresponding sections on correlation and regression from his textbook. This is consistent with his general view that, at least for his mathematics classroom, any "supplementary" materials must be capable of covering assigned topics in an already crowded curriculum. In fact, many of the lesson units were designed with this same philosophy. Andrew found that students were very engaged in this lesson, that males and females alike were not shy about sharing their initial opinions about this topic, that issues of justice and pay equity were natural avenues for broadening the mathematics classroom discussion to the moral realm, and that seemingly contradictory statistical findings arise in everyday applications, requiring careful discernment to avoid unsubstantiated conclusions based upon data.

At the college level, Gary Talsma has used the fifth unit, focused on hypercubes, with both preservice elementary school teachers at Calvin College and a group of mathematically talented middle school students attending a summer math camp at the college. With both groups of learners, this lesson unit simultaneously offered a minimal threshold to understand the initial phases and problem tasks and a series of increasingly complex generalized relationships for higher dimensional cubes. Students appreciated the need to think spatially and reason by analogy. Most of the students also captured the sense of "awe and wonder" at God's creative power and the cognitive reasoning abilities that God has provided to his human creation.

Dave Klanderman found similar reactions from preservice elementary and secondary mathematics teachers as these students worked on applications of the Fibonacci sequence and the golden ratio, both of which are part of the third lesson unit. These future teachers were particularly drawn to the interconnections of various aspects of God's creation and the underlying patterns that can be used to described both the beauty and the order of the world around us. James Bradley used some of the lesson units with college students in a mathematics course for liberal arts majors, and he notes that many of the remaining units would also be appropriate for such a course.

**Recent and upcoming dissemination initiatives**

As was noted earlier in this paper, the goal of this project was to develop a series of mathematics lesson units that integrate moral and spiritual themes that are available free of charge to teachers for classroom use. This goal leads to the necessity of dissemination of materials and information to interested mathematics teachers and school administrators at the middle school, high school,
and college levels. Some of these dissemination initiatives occurred during 2006 while others occurred during 2007 or will occur later in 2007.

Andrew Busch and Dave Klanderman offered multiple workshops for middle school and high school teachers at the B.J. Haan Conference hosted by Dordt College in Sioux Center, Iowa in spring 2006. Conference attendees were primarily mathematics teachers from Christian Schools in Iowa, South Dakota, Minnesota, and Illinois. Sample materials, in draft form, were distributed and attendees were encouraged to contact members of the writing team for access to the final versions of the lesson units. Several teachers later requested this information.

During summer 2006, Mandi Maxwell of Trinity Christian College traveled with a group of educators to Tanzania. She led several workshops with mathematics teachers who teach in rural high schools in Tanzania. During one of these workshops, she used materials from the third lesson unit, and the teachers seemed eager to make links between spirals on pinecones, which are readily available in the area, and the Fibonacci sequence. Access to technology is very limited in this area, so it may prove difficult for these teachers to access and implement some of the other lesson units.

During summer 2007, James Bradley and Gary Talsma led a week-long series of workshops at Calvin College in Michigan. A total of 19 teachers, including a few at the elementary and middle school level and a few at the college level, participated in the workshops. The teachers responded very positively to the materials. Many plan to use the materials in their classrooms, and some plan to write future lesson units. Once reviewed by the Kuyers Institute, these units will be added to the existing set of available lesson units.

During fall 2007, Dave Klanderman and Mandi Maxwell will present an overview these materials at a session at the annual Christian Educators Association Convention in South Bend, Indiana. Teachers who attend this session may choose to take a CD containing all of the lesson units. Also during fall 2007, an article written by James Bradley that describes this project will appear in a publication of the Association of Christian Schools International [1].

Conclusion

A total of three years were required to develop, pilot, and revise a total of nine lesson units. Dissemination initiatives, begun in 2006 and continuing during fall 2007, are designed to make these classroom material available to the widest possible audience at Christian and public schools, both in the United States and around the world. Future lesson units may be developed by teachers who adopt and adapt these materials and decide to extend this integrative approach to other mathematical concepts in the middle school and high school curriculum. The members of the writing team hope that these materials will serve as a valuable resource for any teacher who is interested in approaching the teaching and learning of mathematics from a Christian Perspective.
References


