

THE EFFECT OF THE USE OF CHRISTIAN-PUBLISHED SCIENCE
TEXTBOOKS ON THE ACT SCIENCE REASONING SUBTEST SCORES
OF MIDWEST CHRISTIAN HIGH SCHOOLS

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Janice Marie Guthrie

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The Effect of the Use of Christian-Published Science Textbooks
on the ACT Science Reasoning Subtest Scores of
Midwest Christian High Schools

by Janice Marie Guthrie

APPROVED:

COMMITTEE CHAIR

Michelle D. Goodwin, Ed.D.

COMMITTEE MEMBERS

Charles A. Schneider, Ed.D.

James M. Wood, Ph.D.

CHAIR, GRADUATE STUDIES

Scott B. Watson, Ph.D.

Abstract

Janice Marie Guthrie. THE EFFECT OF THE USE OF CHRISTIAN-PUBLISHED SCIENCE TEXTBOOKS ON THE ACT SCIENCE REASONING SUBTEST SCORES OF MIDWEST CHRISTIAN HIGH SCHOOLS. (Under the direction of Dr. Michelle Goodwin) School of Education, April, 2008.

Statistics indicate that students in conservative Christian schools earn higher standardized test scores in mathematics, reading, science, and writing compared to their public school counterparts, while many are criticized for using curricular materials deemed inferior in quality and for employing uncertified and ill-trained teachers. This study investigates the effectiveness of Christian-published science textbooks in preparing students for college-level science courses as measured by the Science Reasoning subtest of the ACT college entrance examination. A questionnaire was sent to conservative Christian high schools in five Midwest states which are affiliated with the American Association of Christian Schools, Association of Christian Schools International, and Oral Roberts University Educational Fellowship. Information gathered on the schools, teachers, facilities, and ACT Science Reasoning scores and the resulting descriptive statistics provide a sketch of the typical Midwest Christian high school. Hypothesis testing resulted in acceptance of the Null Hypothesis: There is no difference between the mean ACT Science Reasoning scores of Midwest Christian high schools using Christian-published science textbooks as compared to those using secular-published science textbooks. Multiple regression analysis on the two publishers represented by the sample statistics, A Beka and Bob Jones University Press, showed no significant difference in the effectiveness of one

publisher over the other. Analysis of the one open-ended question asking *why* each school chooses to use the type of publisher it does led to the issues of worldview instruction and academic rigor as the deciding factors for the selection of one type of publisher over the other.

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CHAPTER ONE: INTRODUCTION

Statistics indicate that students in conservative Christian schools traditionally earn higher average scores on standardized tests in mathematics, reading, science, and writing as compared to their public school counterparts (Council for American Private Education, 2008; National Center for Education Statistics, 2006). Many variables may contribute to this achievement such as enrollment criteria and the socio-economic status of families who can afford a private education. At the same time that these Christian schools are recognized for higher standardized test scores, many are criticized by the public education sector for using curricular materials which are deemed inferior in quality and for employing teachers who are uncertified and ill-trained (Japinga & DeMoor, 2003; Verhaalen, 2007).

This current study intends to investigate the unique approach taken by many Christian schools in the selection of curricular materials for the purpose of preparing students for college. The research investigated specifically the types of science textbook publishers used, whether Christian or secular, and their effectiveness in preparing Christian school students for college-level science courses. The Science Reasoning subtest of the American College Testing (ACT) college entrance examination provided a measurement of that preparedness.

The Problem

The research topic under consideration in this present study concerns the type of curriculum used in the science classes of conservative Christian high schools. The

purpose is to determine if the type of publisher of the high school science textbooks seems to make a difference in preparing Christian school students for the Science Reasoning subtest of the ACT college entrance examination. The ACT scores served as the indicator as to whether the science curriculum being used, specifically the textbook, accomplishes the task of preparing students for college-level academics.

Research Problem

Is there a difference in the scores on the Science Reasoning subtest of the American College Testing college entrance examination of Midwest Christian high schools which use Christian-published science textbooks as compared to the scores of Midwest Christian high schools which use secular-published science textbooks?

Problem Statement

Within the context of Christian schools, the type of science textbook publisher used – whether Christian or secular – will affect students' scores on the Science Reasoning subtest of the ACT college entrance examination.

Hypothesis

The null hypothesis was tested to determine the likelihood of the experimental results occurring by chance alone.

$H_0 : | \mu_1 - \mu_2 | = 0$ There will be no difference between the mean ACT Science Reasoning scores of Midwest Christian high schools which utilize textbooks published by Christian publishing companies in their required high school science courses as compared to those Midwest Christian high schools which utilize textbooks published by secular publishing companies.

Understanding that ACT scores are influenced by many other factors besides the

classroom textbook used, a questionnaire was used to gather additional data on the school, the specific textbook publishers used, the science program, and the qualifications of the science faculty. The responses provided insight into other factors influencing the schools' ACT Science Reasoning scores.

The remainder of Chapter 1 consists of a discussion of the historical context of the Christian school movement, the unique mission of the Christian school as demonstrated by its philosophy and curriculum, the ACT college testing program, and college readiness expectations. Elaboration of the research problem further clarifies the goals and significance of this study. The chapter concludes with an overview of the methodology used in the research, the definitions of key terms used throughout the study, and a brief summary.

Background of the Study

History of Christian Education

The world-wide debate as to what to teach and how to teach it has endured for millennia. Its history can be traced back 6000 years to the mandate of the *shema* of Deuteronomy 6:4-9 (New International Version) which instructs parents to teach diligently the words of the Lord to their children, in and outside the home, morning and night. Listening, talking, and writing skills were the essence of Hebrew education. Throughout the scriptures, the education of children is presented as the responsibility of the parents for the purpose of knowing God and effectively communicating that knowledge to others. Four millennia later, the ancient Greeks and Romans practiced a more philosophical tradition of instruction in the classical curriculum of the *trivium*: grammar, the rules governing linguistics; logic, philosophy and reason; and rhetoric,

effective speech and writing.

The Middle Ages were marked by a distortion of the teachings of Christ resulting from an attempt to meld the philosophical and intellectual speculations of the Greeks with the traditions of the early New Testament church. Education became religious, but not Christian; the agent of education was the church; the teachers were clerics; and the curriculum consisted of a range of medieval teachings (Eavey, 1964).

Faith-based education in the United States is rooted in the Protestant Reformation led by Martin Luther in early 16th century Europe. No longer seen as an exclusive privilege of the elite or wealthy Europeans, education was offered to all people for the purpose of reading the Holy Scriptures. Education brought power and conflict to the average citizen. Two hundred years later, America's Founding Fathers, recognizing the religious persecution experienced throughout Europe after the Reformation, determined that the young colonies would provide a haven for freedom of religious expression (Barton, 1992). As a result such groups as the Presbyterians, Baptists, Methodists, Congregationalists, and Quakers sought to teach their children the religious convictions of their faith without persecution (United States Government, 2007). These early American schools were established specifically for the religious education of children and were taught by the leaders of the various sects.

Horace Mann's common schools of the early 1800s introduced the American concept of free public education for all children without the bent of religion. A century later John Dewey, champion of social and democratic causes, shifted the focus of American education from being God-centered to child-centered, grounding public education in the psychological and physical experiences of the child (PBS, 2001). The

importance of the individual and one's personal rights contributed to the rise of liberalism in the 1950s. Rejection of authority, characterized by protests and a push for rejection of past traditions, characterized the 1960s. The *me*-generation of the 1970s ushered in civil rights, the women's movements, and environmental awareness (Lone Starr College, 2008). Each decade was viewed by Christians as an intentional movement away from conservative values and biblical authority, providing the impetus for the modern conservative Christian school movement.

The 1980s represented a pivotal era for American religious private schools. One's religious beliefs were viewed as private and personal, totally segregated from public view particularly in the world of academia (Pike, 2004). Not only were traditional Judeo-Christian values in education being supplanted by the philosophies of Dewey and Mann, but the end product of an American public school education had come into question with the sobering statistics in *A Nation at Risk*. A shortage of qualified teachers, dilution of the school curriculum, lack of course rigor, and a decrease in time spent on academics were cited as the over-arching problems in the American education system (Kohli, 2000; National Commission on Excellence in Education, 1983). Christian parents were looking for an alternative to the government schools and an educational philosophy which was congruent with the values of the family.

Christian Philosophy of Education

The major tenants of Christianity center on three themes: creation, the fall of humanity, and redemption (Fennema, 2001; Horton, 1992). Creation, as recorded in the book of Genesis, was an act of God. Human beings were created in God's image, unique and separate from all other life forms, and possessing an eternal soul. God, as author and

creator of all things, is the sustainer of the universe and has charged human beings with the care and management of creation (Genesis 1-2; Psalm 8; Colossians 1: 16-17). The disobedience of Adam and Eve, as recorded in Genesis 3, marred the image of God in the human race, and subsequently, a sin nature was passed to all future generations. In believing that Jesus Christ is the only Son of God, born of a virgin, crucified to bear the consequences of that sinful nature, and risen from the dead to defeat death itself, the restoration of God's image is accomplished through faith (John 3:16). God's written communication to humanity is through the Holy Bible, and it is this Word of God which conveys truth, ethics, and righteous living (II Timothy 3:16).

Christian education centers on a clear understanding of the three themes of creation, the fall, and restoration. Each has a direct impact on key areas of Christian schooling. Recognizing the Bible as the ultimate authority, it clarifies a correct biblical philosophy of education and drives the practices, policies, and programs of the school. The Bible serves as the standard, making no distinction between what is sacred and what is secular, seamlessly integrating faith and learning (Hull, 2003).

A Christian philosophy of education addresses life's greatest questions: Who am I? Where did I come from? What happens to me after I die? What is the purpose of life? Is there an ultimate truth? Answers to these life questions can be found in the Holy Scriptures which are viewed as authoritative and true. Education is understood to be a moral and theological endeavor which intentionally addresses each of these life questions, restoring the broken relationship with God, and assisting young people in their journey toward Godly character and actions (Horton, 1992).

Parents acknowledge their primary responsibility in teaching their children

(Deuteronomy 6: 4-9) and recognize the church and the Christian school as an extension of their home (Horton, 1992). The student is identified as a cherished creation of God, possessing more than a mere physical being. The triune nature of the student is recognized as consisting of spirit, mind, and body, and a biblical education addresses each of these facets (Cates, 1975; Deckard & DeWitt, 2003). Teachers who are committed to truth and academic excellence understand the balance of their authority with their service and actively model Christ in their actions, attitudes, and approach to education (Capehart, 2000; Hyman, 2003). Relationship, respect, and responsibility become the basis for classroom management (Holtrop, 1996).

The ethos of the school is defined as a community of like-minded believers who possess a common vision and mission to close the gap between what is and the ideal proposed by scripture (Hull, 2003; Kienel, 1981; Walford, 2002). Knowledge is based on truth, and truth is based on the character of God. The curriculum becomes the vehicle which facilitates the personal transformation of the student toward a mature relationship with Jesus Christ, enabling the student to separate truth from error in all aspects of life (Cates, 1975; Furst, 2005). Although curriculum content may be very similar to that found in state and national standards, the basic assumptions under which it is taught are uniquely different. The structured, systematic hierarchy of knowledge points to God and unifies subject content under the umbrella of the creation-fall-redemption theme.

Pedagogy becomes a means to an end and is carefully selected for effectiveness and efficiency. Diverse and engaging teaching methods are selected for their ability to point toward God through academic excellence. Curriculum materials are evaluated through the lens of scripture, gleaning best practices from all types of research (Cates,

1975; Holtrop, 1996; Horton, 1992; Kienel, 1981). The typical pattern of instruction proceeds from an introduction through review and preparation for the day's lesson, interpretation of new material for clarification, interaction between the students, teacher, and the new material, the integration of the subject into previous and future knowledge, and practical application of the knowledge (Cates, 1975).

Christian schools may differ in enrollment criteria, forms of governance, and even choice of curriculum materials (Poyntz, 1994), but they agree upon the major distinctives of Christian education. Glenn Schultz (2002) summarizes the absolutes of Christian education as:

1. The education of children is the primary responsibility of the parents.
2. The goal of education is the salvation and discipleship of the next generation who possess a belief system or worldview reflecting Scriptural principles.
3. Education is based on the Holy Bible as the source of absolute truth.
4. Education holds Jesus Christ as preeminent in the life of the individual.

It has been shown that conservative Christians believe that children are created in the image of God and possess eternal souls (Psalm 127:3). Education, therefore, is considered the vehicle by which the spiritual, mental, and physical development of a child is cultivated (Proverbs 22:6). Conservative Christian parents do not compartmentalize life into secular and sacred. Academia and faith are inextricably interwoven into the education of the child (Pike, 2004), and the school is seen as an extension of the values and beliefs taught in the home and church (Walford, 2002).

A Christian philosophy of education flows from these biblical principles and promotes a worldview which addresses truth, reality, authority, the role of the teacher, the

student's responsibility, the curriculum, and pedagogy. Teaching Godly living and fidelity to the Scriptures become equal with the academics of what a student should know and be able to do.

The ACT College Entrance Examination

The goal of education is preparation – whether it is for the next level of instruction, for acceptance into college, for the development of skills needed for the workplace, or, as more broadly defined above by the Christian education community, for knowing God, discerning truth, and restoring lost fellowship with God. Education looks to the future. For the purposes of this current study, the students' preparation for success in introductory college-level science courses represents the outcome of interest. A quantitative measure of preparedness is derived from students' scores on the Science Reasoning component of the ACT college entrance examination and allows extrapolation backwards to the type of science curriculum materials used. The intent is to examine the science curriculum in Christian schools and measure its effectiveness in preparing high school graduates for success in introductory science courses in college as indicated by the ACT Science Reasoning scores.

That students graduate from high school with the skills necessary to be successful in the college or university environment is the expectation. Merely fulfilling high school graduation requirements, however, may make a student eligible for college, but graduation from high school does not necessarily equate with adequate preparation to succeed at college-level work (Cline, Bissell, Hafner, & Katz, 2007). The assumption of this current research is that academic achievement in high school is an indicator of college readiness and that college readiness can be measured by a student's score on the

ACT college entrance examination.

In the early 1900s one national test was used by colleges for screening the most academically promising applicants. That test was the Scholastic Aptitude Test (SAT) produced by The College Board (College Board, 2008). All other students aspiring college acceptance were required to take individual entrance examinations offered by the college or university or had some privileged connection to the institutions through friends or family members. During the 1950s and parallel to the early growth of the conservative Christian school movement, The American College Testing Program, Inc., now just called the ACT, was founded. In response to the growing number of students desiring a college education, the ACT purposed to assist students in making informed decisions regarding which colleges to attend and which programs to pursue. Although both the SAT and ACT are accepted nationwide, the SAT is commonly used by colleges and universities on the Coasts, whereas the ACT is used more widely in the schools of the Midwest, mountain, and southern states (Admissions Consultants, 2008; Hebert, 2007; Maier, 2008; McDaniel, 2006).

ACT, Inc. has grown internationally in its support of education and the workplace. The organization now plays an active role in education policy through its scholarly research dealing with several facets of education. The ACT serves educators through their publications, the standardized tests available for fourth, eighth, and tenth graders, the ACT college entrance examination, and, nationally, through the National Curriculum Survey. Helping students achieve success in education and in the workplace is the mission of the ACT, and this is accomplished by means of seven organizational values:

- Excellence in all aspects of their work;
- Mutual respect, fairness, and visionary leadership;
- Diversity in people and ideas;
- Individual growth and development;
- Courteous, responsive, ethical relations with clients and colleagues;
- Conscientious citizenship and constructive engagement in civic life; and
- Partnership with other organizations (ACT Inc, 2008a).

Information gathered during the administration of the ACT test falls into four general areas: 1) The actual ACT subtest scores and composite scores, 2) student demographic information, 3) student self-reported course-of-study and grade information, and 4) an ACT interest inventory. From the information gathered, high schools are able to evaluate the effectiveness of the instructional programs, identify students who are deficient in specific areas of the curriculum, and plan for improvements in the curriculum. Colleges and universities use the information as a component of the admissions process, for remedial and advanced course placement, for academic advising relating to course of study, for identification of extracurricular activities and employment opportunities, and for scholarship and loan eligibility (ACT Inc, 2008c).

Four subtests in English, mathematics, science, and reading comprise the ACT college entrance examination. Each subtest is scored on a scale of 1 to 36, and a student's composite score is an average of the four scores earned. An average of 36, therefore, would constitute a perfect score. Not included in the composite score is an optional writing component which is scored separately on a scale from 0 to 12 (ACT Inc, 2008e; Kaplan: Test Prep and Admissions, 2008c).

The Science Reasoning portion of the ACT test is the focus of interest in the current research. This subtest consists of six or seven science passages, each followed by five to seven multiple choice questions. The total of 40 multiple choice questions must be completed within 35 minutes (ACT, Inc, 2008f). Rather than testing science content knowledge, this test component draws upon the students' experiences in biology, physical science, chemistry, and physics. Students are required to demonstrate scientific reasoning and higher-order thinking skills in the interpretation, analysis and evaluation of data representations and research summaries, advanced problem-solving, and analysis of conflicting scientific viewpoints (Barnes & Noble, 2008; SAT/ACT Prep Online, 2008).

According to the ACT, a composite score of 20 to 36 indicates the student is prepared to enter college through traditional acceptance channels without remediation. A score of 27 or higher indicates a student is most likely in the top 10% of his or her graduating class and can confidently be considered for admission to highly selective universities (ACT Inc, 2008e). As a result of the ACT being the primary college entrance examination in the Midwest and the SAT not offering a science component, the ACT Science Reasoning scores were selected for the present study.

College Readiness

The United States Department of Labor and Statistics indicates an abundance of jobs available in the 21st Century for individuals with a minimum of a high school diploma (Crosby & Moncruz, 2006). If an above-average income is a goal, however, additional training is necessary. Students must graduate from high school with the skills necessary to be successful in a college or university environment as well as in the workforce. According to Conley (2008), "The likelihood that students will make a

successful transition to the college environment is often a function of their readiness – the degree to which previous educational and personal experiences have equipped them for the expectations and demands they will encounter in college” (p. 24).

The pundits of education define college readiness in a variety of ways. The College Readiness Report broadly defines readiness as the “acquisition of the knowledge and skills necessary to succeed in entry-level college courses without the need for remediation or developmental services” (ACT Inc, 2008f, p. 15). Byrd (2005) offers a more tangible definition with his organization of ten themes into the four general categories of time management, background and life experiences, goal focus, and a strong sense of identity as a college student. Time management, reading ability, study skills, and the ability to adapt to new situations were identified by Hazard and Nadeau (2006) as the habits of the mind predicting success. Spence (2007) simply states reading, writing, and mathematics as the essential skills for college success.

A more thorough portrait of the college-prepared student highlights the following list of attributes (Cline, et al, 2007; Conley, 2008):

1. Cognitive strategies including analysis, interpretation, precision and accuracy, problem-solving skills, reasoning, and research abilities.
2. Key content knowledge, the most important of which include the communication skills of writing, speaking, listening, discussing, and reading, in addition to the main concepts and basic vocabulary associated with the academic content areas.
3. Self-management behaviors such as time management, effective study skills, and persistence.
4. Contextual skills and knowledge which allow the student to function in diverse

settings and adapt to changes imposed by acculturation to college.

This level of mental sophistication indicates a rigorous and effective high school education. The current study attempts to discern the level of science preparedness achieved by Midwest Christian schools as measured by the ACT Science Reasoning scores, and then link this preparation to the type of textbook publisher used in the science curriculum.

The academic achievement of students in the private sector is commendable as shown by research. Interestingly, however, during the 1999-2000 school year, 30% of private school teachers were teaching out-of-field as compared to 10% of public school teachers. Private schools, particularly conservative Christian schools, educate students at a lower cost, with fewer in-field teachers, and use curricular materials deemed by many as inferior (Newsome, 2005). With the exception of safety regulations, Christian schools are not subject to the dictates of the state concerning curriculum standards or standardized tests, yet they reap high achievement scores as compared to public school students. Parents choose to pay tuitions above and beyond their property taxes levied to maintain the local public schools.

What can account for this paradox? Herrington (2000) concluded that the modern educational reform movement, with its focus on improving student achievement and standardized testing, may be missing something by not including values education, interpersonal relationships, personal responsibility, and a sense of community characteristically found in religious schools. Could the ethos of the conservative Christian school, or its unique approach to the Christian school curriculum, or the type of textbook publisher used explain the achievement scores? What accounts for the relative success on

the ACT demonstrated by Christian schools? Could Christian schools be preparing their students for successful experiences in college through their unique approach to the science curriculum?

The Professional Significance of the Study

This introduction has shown that conservative Christian schools have earned a place in the broader education community, and, therefore, their policies and practices warrant investigation. The National Center for Education Statistics (NCES) recognizes conservative Christian schools as those with memberships in at least one of four major associations – Accelerated Christian Education (ACE), American Association of Christian Schools (AACCS), Association of Christian Schools International (ACSI), or Oral Roberts University Educational Fellowship (ORUEF). According to the NCES, 24 percent of the nation’s schools are nonpublic. Of these, there are approximately 6,000 conservative Christian schools, educating almost one million students, and employing almost 90,000 teachers, second only to Catholic and Lutheran non-public schools (National Center for Education Statistics, 2008a, 2008c).

Within the Christian school community, there is much discussion as to the value and appropriateness of using science textbooks produced by Christian publishing companies as opposed to secular publishing companies. There are those who believe it is critical to use Christian-published materials exclusively throughout a child’s educational experience for the essential integration of faith and values with a consistent biblical worldview interwoven throughout subject content. Christian school textbooks are to be “free from political and philosophical influences that contradict the beliefs and values we hold dear...” (Galloway, 2007, p. 5). Others within the Christian school community hold

that secular materials find their usefulness in the skill and ability of the Christian classroom teacher to use the text artfully in teaching a biblical worldview (K. Hall, personal communication, April 8, 2008). This current study does not investigate the effectiveness of these textbook publishers in teaching a biblical worldview, but rather whether Christian-published textbooks are effective in preparing students for college as measured by the Science Reasoning component of the ACT college entrance examination.

This current study contributes significantly to the body of knowledge relating to Christian schools in general and, more specifically, to the examination of the science curriculum used by those schools. In addition, the results serve Christian school administrators and classroom teachers by providing insight into the value and effectiveness of Christian-published science textbooks in providing the content knowledge and thinking skills necessary for the students' academic success in college.

Overview of the Methodology

Conservative Christian schools comprise the third largest group of private religious schools in America and consistently earn higher scores on standardized tests than their public school counterparts (Council for American Private Education, 2008). By earning a place in the broader scope of educational discussion in the United States, the policies and procedures governing their curricula warrant investigation. The purpose of this research was to determine if there is a causal relationship between the scores on the Science Reasoning subtest of the ACT college entrance examination for the Class of 2008 and the antecedent use of Christian-published textbooks in the required high school science courses.

Is there a difference in the scores on the Science Reasoning subtest of the American College Testing college entrance examination of Midwest Christian high schools which use Christian-published science textbooks as compared to the scores of Midwest Christian high schools which use secular-published science textbooks? This question was approached from a causal, correlational, and survey research design. Data on each school's ACT Science Reasoning score for the Class of 2008, the type of textbook publisher used, and several types of anecdotal information were gathered by means of a questionnaire distributed to members of the American Association of Christian Schools, Association of Christian Schools International, and Oral Roberts University Educational Fellowship in the Midwest states of Illinois, Indiana, Michigan, Ohio and Wisconsin. The data were then analyzed by means of various levels of statistical analysis. The first level of analysis used descriptive statistics to define the population. A second level of hypothesis testing addressed the research question relating ACT Science Reasoning scores to the type of science textbook publisher, whether Christian or secular. A third level of regression analysis examined the correlation between ACT scores and the individual publishing companies represented by the school sample. The last level of analysis consists of an examination of the responses to one open-ended question leading to an understanding of why Christian schools differ in their preference for one type of textbook publisher over the other. Details of the methodology, including sampling procedures and specific data gathered, are discussed more completely in Chapter 3.

Definition of Terms

1. *ACT* - The ACT is one of two major examinations used by colleges and

universities as a tool in the college admissions process and as a predictor of academic success at the college level. This multiple choice test is composed of four subtests in English, mathematics, science, and reading with an optional writing component. Composite scores range from 1 to 36.

2. *ACT Science Reasoning test* - The ACT Science Reasoning test is the fourth subtest of the ACT which evaluates a student's ability to interpret data, understand the methods and tools used in experimentation, evaluate models, make inferences, and draw conclusions from data. Each sub-score ranges from 1 to 36.
3. *Christian publishing company* - A Christian textbook publishing company is defined as one which services home schools and Christian day schools by providing textbooks, curriculum materials, products, and services which emphasizes conservative values and teaches a biblical worldview throughout their products.
4. *Christian science textbook* - A Christian science textbook, published by a Christian publishing company, is one deemed suitable for use in Christian day schools due to its compliance with values important to the conservative Christian community.
5. *Conservative Christian school, Christian day school, or Christian school* - As defined by the United States government, a conservative Christian school is one which holds membership in at least one of four associations – Accelerated Christian Education, American Association of Christian Schools, Association of Christian Schools International, or Oral Roberts University Education Fellowship. Conservative Christian schools include a variety of Protestant denominations, but

all have a religious orientation which espouses traditional Christian beliefs, values, and practices.

6. *College readiness or college preparedness* - College readiness or college preparedness refers to the mastery of those essential skills and abilities necessary for enrollment and academic success in first-year college courses without the need for remediation. Proficiency in reading, writing, mathematics, and time management, along with effective study skills and the ability to analyze and synthesize content, are the major traits of a college-ready student.
7. *Evangelical Christians* - Evangelical Christians are both socially and theologically conservative. The major tenets of the faith include biblical authority, Jesus Christ as the Son of God and promised Messiah, the gospel (Good News) of Jesus Christ, and a personal relationship with Jesus Christ through faith in His death, burial, and resurrection.
8. *Midwest states* - For the purposes of this study the Midwest states include Illinois, Indiana, Michigan, Ohio, and Wisconsin.
9. *Philosophy of education* - A philosophy of education is a system of fundamental, motivating principles which serve as the basis for defining what is of value in education and what subsequently drives actions. A philosophy of education addresses the source of authority or truth, subject content, the role of the teacher, the characteristics of the learner, pedagogy, and the decision-making process.
10. *Private school or non-public school* - As defined by the United States Government, a private school is a religiously-affiliated or nonsectarian school which is not supported primarily by public funds, provides instruction for one or

more grades K-12 or comparable ungraded levels, and has one or more teachers.

Home schools are not considered private schools.

11. *Secular publishing company* A secular textbook publishing company is defined as one which services public schools and universities by providing textbooks, curriculum materials, products and services to the public educational community.
12. *Secular science textbook* A secular science textbook is one published by one of the many secular publishing companies and used in public schools and universities throughout the United States.
13. *Textbook* – A textbook is a subject-specific, print-format, standardized book designed for instructional purposes in an instructional setting. A textbook is used by students as a source of content information and by teachers as an instructional tool.

Summary

Chapter 1 has provided an overview of the context in which the current research was conducted. Comprising the third largest group of private religious schools in America, conservative Christian schools possess a unique philosophy of education grounded in biblical principles, defining the beliefs and values held by the schools and driving policy and practice. Christian school students have been recognized for their academic achievement on standardized assessments for many years, indicating a measure of success in the choice of classroom curricular materials. This investigation looked specifically into the science education in Christian schools to determine the effectiveness of the publishers of the science textbooks. Does it make a difference whether the high school science textbooks are published by Christian or secular publishing companies? In

seeking the answer to this question, the concept of college readiness was used to indicate the effectiveness of the science curriculum. Students' scores on the Science Reasoning subtest of the ACT college entrance examination served as a quantitative measurement of that readiness.

Chapter 2 reviews the existing theoretical and empirical research associated with the study. Learning theory, curriculum theory in the Christian school, Christian school data, the role of the Christian teacher, and textbook in education are examined as to their influence on student achievement. The validity of the ACT test and college readiness research gives credence to their use as indicators of a successful curriculum. The chapter closes with an examination of several major publishing companies providing high school science textbooks to the Christian education community. The similarities and differences of both Christian and secular companies are examined with an emphasis on research showing any relationships to student achievement.

CHAPTER TWO: REVIEW OF LITERATURE

Chapter 2 explores the limited research literature contributing to the body of knowledge regarding Christian schools, student achievement, and textbooks. Both theoretical and empirical research in the areas of learning theory, curriculum theory, ACT College testing, college readiness, and the role of textbooks in education are examined in order to identify the impact of each on the unique mission of Christian education. An investigation of secular and Christian textbook publishing companies reveals similarities and differences in their goals and missions in providing services to the educational community. The chapter concludes with a summary of the intent of the current research.

Theoretical Framework

Learning Theory

Three prevalent learning theories have dominated curriculum theory for the last century. Each is unique in its presuppositions regarding what students should know, how learning should be organized, and how students best learn (Welled-Strand & Tjeldvoll, 2003). Although Behaviorism, Cognitivism, and Constructivism are discussed here as three independent entities, they actually represent points on the continuum of learning theory.

Names like Skinner, Pavlov, Thorndike, Bandura, Mager, Gagne, and Merrill led the way for the behaviorist movement in the early 20th century. This philosophy contends that reality exists in the world separate from personal experience (University of Washington, 2003). Learning occurs when the student responds correctly to the appropriate stimuli (Graham, 2007). *Behavioral objectives, training simulators,*

performance-based assessment, and *programmed learning* became the buzzwords of that era. The teacher communicates the lesson through highly structured and carefully planned presentations; the students are given time to interact with the information and formulate responses; and training in the form of drill, practice and regular assessment solidify knowledge and skills in the learner. Successful teaching is identified when certain performance objectives are met (Carbonell, 2004; George Mason University, 2006; Virginia Community College System, 1998).

The mid 20th century saw the emergence of theories on information processing, giving rise to cognitivism. Bruner, Merrill, Miller, and Vygotsky believe that an individual's knowledge base can be enhanced by interaction with peers. Learning is now seen as a developmental process, and effective learning is accomplished when the student is mentally able to organize, store, and retrieve information (George Mason University, 2006; Virginia Community College System, 1998). Learning style inventories became popular to describe how the mind processes information. Kolb (1984) described learning as concrete experience, reflective observation, abstract conceptualization, or active experimentation. Gardner (1997) identified eight intelligences explaining how students learn. Three of these, auditory, visual, and kinesthetic, had particular application to education. Terms like *chunking*, *mental models*, *learning strategies*, *task analysis*, *discovery learning*, and *gestalt* became popular. Teaching methods reflected these new theories, and problem-solving activities were structured to raise students' cognitive levels through social interactions. The student assumed an active role in the learning process, and teaching became student-centered (Carbonell, 2004).

Constructivism is the current learning theory. Men like Dewey, Knowles, Bruner,

and Piaget argue there are many ways to structure knowledge. Knowledge and its meaning arise from the individual student's personal experience and interpretation of reality and are constructed from prior knowledge through collaboration with others (George Mason University, 2006). Knowledge is seen as valuable only when it is used to solve real-life problems or is personally meaningful. The concept that knowledge is socially constructed rather than passively acquired changed the role of the teacher to mentor or facilitator (Terwel, 1999; Virginia Community College System, 1998). Individual interpretation of reality results in no "correct" answer to a problem since the process is more important than the product. Assessment of the student's progress occurs throughout the learning process through anecdotal notes, impressions, and level of participation. The Constructivists' vocabulary includes words like *schema*, *social-cultural learning*, *action learning*, *collaboration*, *problem-based learning*, *mental models*, *discovery learning*, and *authentic assessment* (Carbonell, 2004; Kearsley, 2007).

Curriculum Theory in the Christian School

The design of any curriculum reflects what the theorists deem as important components. In the 1940s curriculum design focused on learning activities rather than subjects, while the 1950s emphasized social experiences and issues, the humanities, and civic responsibility. Each approach to the curriculum mirrored the popular learning theory of the day. The launching of *Sputnik* in 1957 by the Soviet Union jolted the United States into a realization that the American education system was in need of its own reformation in order to reclaim its place as world leader in science and technology (Pattison & Berkas, 2000; Wiles & Bondi, 2004). The realization that the United States was falling behind in mathematics and the sciences resulted in a sharp increase in

professional development activities for teachers, Title 1 programs for low income students, and Head Start for preschoolers. The 1960s ushered in a new era of responsibility and accountability in schools.

The concept that all students should be taught the same content first appeared in the 1960s as the core subjects of the common curriculum. The 1970s was an era of methodologies, learning objectives, and testing (Short, 1986; Marsh & Willis, 2003). New teachers were required to pass competency assessments, and in-service teachers were required regular re-certification (Wiles & Bondi, 2004). Christian families were looking for alternatives to what was being offered in the public educational arena.

Christian schools, however, continued to maintain a curriculum relatively unaffected by the influences of the latest theory and characterized by the distinctives which identify them as Christian. The major curriculum content areas are clearly identified in scripture – language arts (Deuteronomy 6), science and mathematics (Romans 1), social studies (Psalm 78), physical education (Romans 12), and the fine arts (I Kings 7). These are the same content areas identified within the curriculum of public schools. The sharing of curricular materials, standards, and benchmarks, however, reflects the sharp contrast in educational philosophy between public and conservative Christian education. For Christians there can be no separation between faith and learning. A biblical worldview through which all subjects are seen makes Christian education unique. The characteristics identifying Christian schools as effective go beyond the curriculum to include the development of the Christian mind, recognition of gifts and talents, pedagogy based on a Christian philosophy of education, exploration of the world as God's creation, the provision of an enabling environment for teachers and students, an

attitude of inclusion, and academic excellence (Vander Walt & Zecha, 2004). Education is viewed as a theological and moral activity in which the curriculum is a tool used to unify the principles of life (D'Souza, 2000).

The Role of the Christian Teacher

The identification of effective teaching and learning is governed by the theoretical framework which defines how students learn. The framework, in turn, dictates how teachers teach. The instructional practices of the teacher believed to be most effective in achieving student learning will then be influenced by that theoretical framework. The pedagogy employed in the classroom, the subject content, and the methods used for assessing student achievement are unique to the theory of learning espoused by each individual educator.

What constitutes a master teacher has followed the evolution of learning theory and curriculum theory. At the turn of the 20th Century, best teaching practices were based on the teacher's ability to help students master skills and subject content for the purposes of promotion into the next grade level. Teachers were required to be knowledgeable in their academic fields and understand their students (Brogan, 1936). During the second half of the 20th century, effective teaching was identified by the application of learning styles, brain research, critical thinking, and multiple intelligences in classroom pedagogy (Danielson & McGreal, 2000). The constructivist teacher is deemed successful when there is less group instruction and more student-centered activities.

A notable example of qualitative research in teacher expertise was conducted by Smith and Strahan (2004). After intense study of three master teachers, the authors revealed six domains of expertise: personal, classroom, instructional, student,

professional, and content. These led to six central tendencies which characterize expert teachers: personal confidence, a sense of the classroom as a community, a genuine concern for the students, student-centered instruction, participation in professional leadership and service opportunities, and mastery of content.

Quantitative research has led to the core propositions of the National Board for Professional Teaching Standards (NBPTS) (2004). Expertise in the areas of content knowledge, skills, dispositions, and beliefs are at the heart of the propositions and subject-specific standards of the NBPTS. Other sources of quantitative data identify teacher expertise by years of experience, certification, college major (Breaden, 2008), the quality of the pre-service preparation (Keller, 2008), and whether or not they became teachers after the NCLB mandates were in place (Smith, 2008).

A strong sense of the calling of God upon their lives to the profession of teaching and loyalty to the individual school is the centerpiece for Christian school teachers. Teaching is a ministry to the spirit, mind, and body of a child in which wisdom and understanding become as important as content knowledge (Lowrie, 1978). What the teacher says, how it is said, and the teacher's personal conduct become the major tools of influence in leading a child into a personal relationship with Jesus Christ, helping that child grow into spiritual, mental, and physical maturity, and building upon the child's gifts and abilities (Schultz, 1998). Gaebelein (1954/1968) contends that in the classroom

[t]he fact is inescapable: the worldview of the teacher, in so far as he is effective, gradually conditions the world view of the pupil. No man teaches out of a philosophical vacuum. In one way or another, every teacher expresses the convictions he lives by, whether they be spiritually positive or negative (p. 37).

Although the subject content is often identical to that of the public school, the worldview through which that content is taught is defined by biblical standards.

Holtrop (1996) summarized what Christian education entails by describing a Christian teacher as engaging in

purposeful education, education with impact, education that is student-centered *and* subject-centered *and* teacher-centered in the sense that the responsibility is spread all around. We need responsible students who are taught by responsible teachers who use responsible materials and methods. This means students take responsibility for their own learning; teachers take their job as a divine calling to a fully professional endeavor; and curricular materials are not sugar-coated, censored, vacuous and dry, nor merely politically correct.... Materials and methods should represent the best that both traditional education and current research have to offer while at the same time promoting the goal of responsibility-building in individuals and toward our culture and the world (§ 21).

Historically, the teacher has been seen as the critical component in improving student achievement. The identification of effective teaching and learning, however, is governed by the theoretical framework which defines how students learn. Identifying the framework in turn dictates what is of value to be learned and how teachers should teach. The most effective instructional practices of the teacher are, therefore, influenced by that theoretical framework. The pedagogy employed in the classroom, the subject content, and the methods used for assessing student achievement are unique to the learning theory espoused by each individual educator. In order to understand the uniqueness of Christian education, the history of learning theory is examined and how theory drives practice.

The various theories regarding how students learn dictate what constitutes effective teaching. In accordance with the Christian distinctive listed above, the teacher in a Christian school is required to align theory and practice with scriptural insights on teaching and learning. The effectiveness of the teaching style is verified in the outcome – improved student achievement.

What, then, constitutes good teaching? Is it a function of innate ability, a set of measurable skills and practices which can be acquired, or following the tenets of a particular learning theory? Is it in the mind-set of the teacher? Is good teaching dependent on the teacher or the student? Perhaps all of these factors contribute to mastery of the art of teaching resulting in improved student achievement.

Improving student achievement through accountability gave momentum to the passage of the *No Child Left Behind (NCLB) Act of 2001* (2001) and the subsequent state-mandated initiatives. The NCLB Act urged educators to use rigorous scientifically-based research for the identification of effective teaching (U.S. Department of Education, 2003). These effective practices align themselves with the results of experimental research which has produced prescriptions for success in the classroom (Hostetler, 2005).

Research has shown that the greatest negative effect upon student achievement arises from teachers who teach out-of-field or who are uncertified (Mayes, 1992; Padian, 1993; “Study finds improvement,” 2008; Watson, 2006). The compelling evidence that credentialed teachers affect student achievement supersedes experience, class size, language barriers, and the socio-economic characteristics of the students (Clotfelter, Ladd, & Vigdor, 2007; Darling-Hammond, 2000). Advanced certification through the National Board for Professional Teaching Standards has been shown to be even more

effective than teachers holding standard credentials in raising student achievement (“Board-certified teachers,” 2008; Greenberg, E., Rhodes, D., Ye, X., & Stancavage, F., 2004).

Consequently, there is much criticism of Christian education: small schools which value religious convictions above a quality education, ill-prepared and uncertified teachers, and the use of sub-standard curricular materials. Some research, however, has shown initial certification has little, if any, effect on student achievement (Kane, Rockoff, & Staiger, 2008; Sharkey & Goldhaber, 2008). A study conducted through the American Educational Research Association found student achievement more strongly related to teachers’ professional development, a focus on how students learn, classroom management skills and organization, positive relationships, and encouragement of responsibility among the students (Hill & Cohen, 2005).

Each state requires Christian schools to maintain attendance records and comply with safety regulations and health codes. The Christian schools, however, are not held to any state academic framework as are the public schools, or are they required to adhere to the mandates of the No Child Left Behind Act, teacher certification, curriculum standards, or standardized assessments. Yet parents are willing to pay tuition above and beyond their property taxes which fund public education to send their children to these schools (Newsome, 2005). Effective Christian schools are aware that they will lose their credibility with families if they do not provide for quality education.

Although not documented by ACT Inc, composite ACT scores for private school students have been researched nationally and found to be as much as three points higher than those earned by public school students (Council for American Private Education,

2000). As a reputable indicator of high school course rigor and college preparedness, the ACT provides the impetus for examining the Christian school science curriculum in this current study.

Public, Private, and Christian School Data

The National Center for Education Statistics (NCES) collects data annually from public and private schools allowing comparisons of various characteristics regarding schools, students, assessment scores, demographics, expenditures, and programs (National Center for Education Statistics, 2007b). Private schools are defined as religiously-affiliated or nonsectarian schools which are not supported primarily by public funds, provide instruction for one or more grades K-12 or comparable ungraded levels, and have one or more teachers. These non-public schools represent almost 25 % of the nation's schools and educate 11% of the nation's students (Council for American Private Education, 2008). Table 1 compares several key characteristics of public schools, the broad category of private schools, and specifically conservative Christian schools.

Table 1. *A Comparison of Public (2003-04), Private, and Conservative Christian School Populations (2004-05)*

	Public Schools¹	Private Schools²	Conservative Christian Schools²
Number of Students	49,000,000	5,050,000	870,000
Number of Schools	100,000	29,000	6,000
Number of Teachers	3,500,000	480,000	85,000
Teacher:Student Ratio	1 : 16	1 : 12	1 : 12
White : Minority Ratio	2 : 1	3 : 1	3 : 1
Average Cost to Educate Per Student	\$9,000	\$3,500	\$3,000
Graduation Rate	75%	98%	98%

1. (National Center for Education Statistics, 2008b)
2. (National Center for Education Statistics, 2008a, 2008c)

Of the schools classified as private, 81% have some type of religious affiliation with the remaining 19% comprising those nonsectarian schools which claim no religious affiliation. Forty-four percent of private school students attended Catholic schools in the 2005-06 school year, representing the largest single group of private school students. Eighteen percent of the students attend private schools of a variety of religious denominational affiliations such as Baptist, Lutheran, Jewish, or Episcopal. Sixteen percent of private school students attended conservative Christian schools (Council for American Private Education, 2008).

Public school enrollment had grown 16% between the years 1990 and 2005, while the enrollment in private schools had experienced a growth of only eight percent during the same time period. This had been attributed primarily to the drop in enrollment in Catholic schools (National Center for Education Statistics, 2008b). Conservative Christian schools, however, experienced a 36% growth between 1990 and 2005 (National Center for Education Statistics, 2007a). This growth attests to the desire of many families for school choice and an alternative to the shifting values of public education.

Data on the academic achievement of students who attend private schools are available from the three major sources: The Scholastic Aptitude Test (SAT), the National Assessment of Educational Progress (NAEP), and the American College Testing Program (ACT). Administered by the College Board, the SAT assesses students' critical thinking skills, mathematical reasoning abilities, and writing skills. Each of the three subtests is scored on a scale from 200-800. With a perfect score defined as 800 in any single section, the maximum score possible on the SAT is 2400. The average score earned nationally on each subtest of the SAT in 2008 was 500 (College Board, 2008). Twenty percent of the

students taking the SAT were from private religious schools. Table 2 shows the above-average performance of these students as compared to public schools for the year 2003.

Table 2. *A Comparison of Public School and Private Religious School SAT Scores on the Mathematics and Verbal Portions of the SAT: 2003.*

SAT Test Component	National	Public Schools	Private Religious Schools	Independent
Mathematics	519	516	530	573
Verbal	507	504	535	550

(Council for American Private Education, 2003)

Although the National Assessment of Educational Progress (NAEP) is not a college entrance examination, it is widely used to assess the quality of education received by students throughout the United States. The NAEP provides data on student performance in the areas of reading, mathematics, science, and writing in grades 4, 8, and 12. To assist in interpreting the scores, the NAEP has set performance standards denoting levels of mastery: Basic, Proficient, and Advanced. Partial mastery of fundamental knowledge and skills is designated as Basic, whereas competency over challenging subject matter earns the Proficient status. Students demonstrating superior performance on the assessment are granted the Advanced achievement status (Perie, Vanneman, & Goldstein, 2005).

The results of the NAEP are published yearly in *The Nation's Report Card* (Institute of Education Sciences, 2008). The data on the performance of private school

students focus on the three types of schools enrolling the greatest proportion of students: Catholic, Lutheran, and conservative Christian. Students in grades 4, 8, and 12 of the private sector outperformed their public school peers by a margin of 11 to 23 points in all categories since the early 1980s (Council for American Private Education, 2000). A higher percentage of students from the category of private religious schools score at or above the Proficient level than their public school peers. The highest scores on all tests tend to be earned by the Catholic school students, followed by the Lutherans, then conservative Christian school students. Even when adjusting for demographics, socioeconomic status, and gender, some researchers found students from religious schools still scoring above the national average in achievement (Perie et al., 2005).

The ACT

The most widely-accepted college entrance examination is produced by ACT Inc. Curriculum-based, the ACT assesses students' academic knowledge and skill achievement in English (usage, mechanics, rhetoric), mathematics (algebra, geometry), science (biology, physical science, chemistry, physics, earth and space science), and reading (social studies, scientific readings, literature, and the arts). Each of these subtests is scored on a scale of 1 – 36, with the composite score being the average of the four tests. The optional writing component is available and is scored as a separate component. The national average composite score for 2005 graduates was 20.9, 2007 graduates was 21.2, and 2008 graduates was 20.9. The benchmark score defining college readiness on the ACT Science Reasoning subtest for 2008 was 24. Only twenty-eight percent of the students taking the science subtest nationally met the benchmark score with an average score of 20.8 in 2008 (ACT Inc, 2008a).

The questions developed for each subtest are designed to measure those skills which are most important for first-year college success. With 50 years of data amassed by the ACT, the validity of the composite ACT test scores coupled with high school course GPAs in predicting college preparedness has been calculated to have a mean R value of 0.53. The ACT composite scores are also used as one component in validating the effectiveness of the high school academic program by comparing school subtest scores to the ACT benchmark scores established for each of the four subject areas (ACT, Inc., 2007).

In this current study, the ACT Science Reasoning subtest scores are used as a measure of college preparedness and the effectiveness of the high school science program. In 2006, ACT determined the internal consistency of the Science Reasoning subtest as a measure of college readiness in the calculation of the median coefficient of reliability, $r = 0.80$. Ranging from 0 to 1, this r value indicates that 80% of the ACT Science Reasoning scores exhibit true variance with only 20% error (ACT, Inc, 2007). The significance of this r value justifies the use of the ACT Science Reasoning subtest scores as reliable measures of college preparedness.

It is the score on the ACT Science Reasoning subtest which was examined for assessing the effectiveness of the science textbook publisher in the current study. This type of indicator for the effectiveness of the curriculum, however, is not without its critics. Some information points to weak graduation requirements or poor core content as the reasons why students do not meet the college-ready benchmark scores (“ACT scores up,” 2007; Marklein, 2006). Perez (2002) criticizes the ability of the ACT to assess accurately all students due to the inequities for different racial/economic groups and those

students who are able to pay for tutoring assistance. Some authors contend that after statistical adjustments for student characteristics, other standardized test results show no significant difference between the scores of public school students and conservative Christian school students in the areas of mathematics, and public school students may even have a slight advantage over Christian school students in the area of reading (Braun, Jenkins, & Grigg, 2006; Peterson & Llaudet, 2006).

W. James Popham (2006) questions the ability for the ACT test to predict a student's success in college and in later life. His research showed a predictive validity coefficient of 0.50 indicating the ACT score, which becomes branded on the student's mind and heart for life and which categorizes the student's ability to succeed, is correct only 50% of the time. Popham cautions students not to let anyone use a single test score to define who they are or what they can or cannot do. Whatever the rationalization for low or high scores on the ACT or any other standardized test used for predictive purposes, this researcher sees the ACT college entrance examination as the most valid indicator available for measuring college preparedness and the effectiveness of the high school science curriculum.

College Readiness

Texas, a leader in coordinating college readiness standards, has been able to quantify college readiness in terms of a minimum composite score of 23 on the ACT or a combined verbal and mathematics score of 1070 on the SAT. Texas has formally defined readiness as "the acquisition of the knowledge and skills necessary to succeed in entry level college courses without the need for remediation or developmental educational services" (Commission on College Ready Texas, 2007, p. 15). Similarly, The American

Diploma Project has attempted to coordinate college readiness standards across state lines to identify specific benchmarks leading to college preparedness which can be identified, aligned with state standards, and assessed through standardized testing tools (Achieve, Inc., 2008). The three curriculum-based standardized tests available through ACT Inc., the EXPLORE[®] in grade 8, the PLAN[®] in grade 10, and the ACT[®] in grade 12, have allowed the organization to relate test scores to the type of skills necessary for college success. As a result of longitudinal studies of student progress from grade 8 through college, specific learned content and skills have been linked to success in first-year college courses (College Board, 2008). These College Readiness Standards have been shown to be reliable predictors of college success (ACT Inc, 2008d).

The goal of education is preparation. Whether it is to read, write, communicate effectively or provide skills for the workplace, students are expected to know a body of specific information and be able to perform a variety of specific tasks. With this goal in mind, the current study investigates the textbook publisher used in Christian schools throughout five Midwest states in order to link successful ACT scores to the type of textbook publisher used in the required high school science curriculum.

Statistics derived from the 2008 ACT test data indicate only 22% of students entering college are academically ready in all four of the subject areas tested – English, reading, mathematics, and science. Individually, the scores are quite diverse: adequate preparation for English ranked highest with 68% of the students who took the test reaching the benchmarks set for college readiness; reading preparation was second with 53%; mathematics third with 43% of the students reaching the benchmark; science ranked the lowest in the number of students who attained the level of college

preparedness defined by the ACT with only 28% of the students reaching the benchmark score of 24 (ACT Inc, 2008e).

All states require successful completion of a prescribed number of classes to be eligible for high school graduation. In an attempt to standardize the myriad of high school courses offered throughout the United States, the National Assessment of Educational Progress has developed a system of codes used to classify courses according to content and level. Based on 120 hours of in-class time over the period of one school year, the Carnegie Unit has been used since the late 1800s to assess students' attainment of graduation status (National Assessment of Educational Progress, 2005). Declaring a student eligible for college by means of completion of a defined sequence of high school courses, however, has not been shown to translate into college readiness (Cline, et al., 2007).

As a consequence, many states now require a passing grade on a high school exit examination in addition to fulfilling course requirements as prerequisites for graduation. These exit exams test students' knowledge and skill through the equivalent of 10th grade. The concern is that these criteria "send students the message that 10th grade or lower skills comprise an adequate preparation for college" (Kirst & Venezia, 2007, p. 2). These exit examinations measure the specific set of state-defined standards and benchmarks, not the knowledge and skills required for college success (Basken, 2007). Realizing the requirements for graduation and the expectations of colleges and universities may be mutually exclusive, few researchers have delved into why the disparity exists or what to do about it (Knich, 2008).

More than twenty years ago, Laing (1987) determined that college preparatory

coursework was the key to improving ACT scores. In more recent research, ACT scores leading to college success have been linked to taking *more* than the required courses in high school *plus* developing effective study skills ("Call to action," 2004). Kirst and Venezia (2007) and Whelan (2007) counter that more courses are not enough for success in college. Courses must be academically rigorous by providing learning opportunities aligned with college-level expectations. The ACT test scores indicate that the high school curriculum alone does not prepare students for college-level work (Jacobson, 2004). Besides the ability to speak clearly, listen actively, communicate verbally, read critically, and write effectively, students must command a strong vocabulary and be able to participate in productive discussions. Developing keen problem-solving and analytical research skills, coupled with critical reasoning skills, is crucial for this transition (Cline, et al., 2007).

Two organizations have lead in the transition from acknowledging there is a problem with the high school curriculum in its ability to prepare students for college to affecting a plan of action to eliminate the disparity. The most recent of these is the Texas Board of Education. In response to the sobering realization that only 50% of Texas high school graduates were college ready according to 2006 ACT test results, the Commission for a College Ready Texas assumed the task of developing college readiness standards for English, mathematics, science and social studies through research and collaboration K-16. The Commission researched schools throughout the country which had demonstrated excellence in ACT scores in order to identify the skills and content knowledge to be incorporated into each of the Texas grade-level standards. The resulting document, *The Texas College Readiness Standards*, defines college readiness in terms of

skills and knowledge, aligns content with the current K-12 standards and benchmarks, and provides data from research to justify any conclusions drawn (Texas Education Agency, 2007; Weber & Chavez, 2007).

The more global leader in identifying the skills and knowledge needed to experience success at the college level is ACT, Inc. The prolific data amassed enables the ACT to provide individual schools a means of evaluating the effectiveness of instruction, identifying students who need academic support, and assessing the effectiveness of the school's academic curriculum. Colleges use ACT test results as one tool in the college admission process, for course placement, academic advising, and identifying qualifying candidates for scholarships and loans (ACT Inc, 2008e). Identification of specific skills and knowledge plus any necessary corresponding interventions for English, mathematics, reading, and science are charted in The ACT Standards of Transition and Pathway to Success in College. The ACT's recommendation is for high schools to offer courses beyond the minimum four years of English and three years of mathematics, science and social studies to improve readiness. Statistics have shown that taking more rigorous courses of high quality and content results in test gains, regardless of the students' achievement levels within those courses (ACT Inc, 2005).

The Role of Textbooks in Education

When considering approaches for improving student achievement, many educators would respond with such strategies as improving professional development, increasing financial resources, reducing class size, improving facilities, aligning curriculum with assessment, examining scheduling options, or improving teacher skill and content knowledge (House & Taylor, 2003). Citing the curriculum used, or more

specifically, the textbook publisher, is rarely mentioned. Some researchers view the textbook and related curricular materials as the major influence in a student's educational experience and improved academic achievement, second only to the influence of the teacher (Paterson, 2000). The textbook can advance learning goals, structure classroom activities, supply a major source for lesson content, and provide instructional guidance. Accused of serving as the nation's *de facto* curriculum, textbooks are used by more than 90% of all classroom teachers, defining course content and the instructional process (Deckard & Sobko, 1998; House & Taylor, 2003; Koppal & Caldwell, 2004; Tupli & Cook, 1993).

How textbooks are used, or whether they are used at all, is greatly influenced by the teacher's philosophy regarding his or her role in the education process and how students learn (Koppal & Caldwell, 2004). In classrooms where constructivist teachers are facilitators and the instruction is intensely student-centered, the textbook plays a minor role in providing content. The use of online course lectures and webcasting, presentation of content by means of concept maps, and replacing textbooks with popular fiction and nonfiction books has been pursued as substitutes for the traditional textbook. Others have experimented with digital textbooks, video games, *e-books*, and multimedia presentations in an attempt to find the key to improving student achievement and avoiding the use of traditional textbooks.

Results from these creative alternatives to traditional textbooks vary greatly. Ghyam (2007) found no improvement in retention of subject material when content was presented as a webcast, whereas Su (2008) found multimedia presentations as a supplement to instruction beneficial in problem-solving. There was not a statistically

significant difference found by Chen (2007) in the achievement of students who used concept maps as a form of advanced organization of content materials, although he did find them minimally more beneficial for learning than a traditional textbook outline.

Yager and Akcay (2008) found the constructivist emphasis on the students' prior knowledge, current issues, local situations, and personal relevance resulted in no improvement in learning basic science concepts, but it did improve students' attitudes about science, their creativity, and references to science in the home. The authors of one study admit that the use of science fiction and nonfiction books "will not, by [themselves], enhance student learning" (Shibley, Dunbar, Mysliwiec, & Dunbar, 2008, p. 57). In fact, these same authors showed that the use of popular books had its greatest effect in upper-level college courses where students already possessed a strong content base, implying the importance of prior knowledge when seeking an alternative to traditional textbooks. When using electronic or digital textbooks, Christopher (2008) and Luik & Mikk (2008) found that low-achieving students benefited more than high-achieving students. An advertisement appearing in *NEA Today* encourages the use of the video game *Immune Attack* as a method of learning about viruses and immunity. The author claims this alternative to traditional textbook learning *could* have an impact on student achievement (Shalaway, 2006).

In more traditional classrooms the textbook plays a major role in the transmission of content knowledge and as a significant resource for students (Molsbee, 1996 ; Wade & Moje, 2000). Dutch (2005) views textbooks as a valuable tool in the process of lifelong learning. All textbooks are not created equal, however. Other research has shown that different textbooks result in significantly different achievement scores. For example,

Cummins-Colburn (2007) traced the academic achievement of third graders on the Texas Assessment of Knowledge and Skills and found statistically significant differences among the eight different textbooks adopted by the Texas Department of Education for use in the state's third grade math program. The mean percentage scores also varied when the textbooks were compared to ethnicity, gender, Title 1 designation, special education, and student less proficient in the English.

Textbook Evaluation and Selection

Several factors should be considered before a textbook, or a series of textbooks, is adopted by a school, district, or state. Since the purchase represents a major expenditure from the system's budget, the evaluation and selection of a textbook and its ancillaries should be governed by guidelines which assure the purchased curriculum materials match the learning needs of the student body. House and Taylor (2003) recommend:

1. Developing a timetable outlining the chronology of events and deadlines in the process,
2. Involving key people in the process who share the vision of the teaching and learning processes,
3. Identifying the objectives to be accomplished by the new curriculum,
4. Matching the ideal teaching and learning process envisioned by the school with the goals of the curriculum materials being examined,
5. Confirming that the curriculum materials being examined align with state standards,
6. Using the materials on a pilot basis allowing experience with the curriculum before purchase,

7. Examining the assessment materials for compatibility with the school's preferred format,
8. Reviewing validation studies, and
9. Negotiating everything including shipping costs, delivery dates, staff development, and product services.

Recommendations from the American Textbook Council (2008), Norman Herr (2007), and Illinois' Kevin Killion (1999) focus on assessing whether a textbook presents accurate information, is fair and unbiased in the presentation of information, has a clear and comprehensible writing style, end-of-chapter exercises which support chapter content, and relevant illustrations and sidebar entries.

Secular-published Textbooks

Unlike their customers in the educational community, publishing companies are in the business for profit, and the competition is fierce. With over 50% of textbook revenues generated from sales in California, Florida, and Texas alone, the major publishers have posted steady profits over the past several years ("Harcourt prevails in Florida," 2006; "Harcourt textbook business," 2007; "Higher ed drives revenues," 2007). A larger market share results in lower prices and higher accommodation for individual district preferences (Vicard, 1997). The remaining 47 states are left to select their textbooks from those which reflect the unique concessions demanded by influential pressure groups in the three core states.

Prior to NCLB (No Child Left Behind Act, 2001) which requires the effectiveness of curriculum materials be based on scientific research, there was little basis for selecting one publisher over another, except as a response to effective marketing strategies. The

NCLB Act now requires textbook publishers to provide research data supporting the value of their products over their competitors. Publishing companies are expected to produce evidence of enhanced student achievement from experimental research, along with superiority of their products, and commendable customer service in order to propagate sales. Much capital is invested in this research, but very little of the research on a product's effectiveness can be carried out during the developmental phase. During development, evidence is collected verifying alignment with state and national standards, and responses are drafted to the challenges voiced by content editors and focus groups. The curriculum is then field-tested through pilot studies lasting several months, after which the statistical data is amassed and analyzed. By the time the report is ready for publication and further marketing can proceed, the six-year adoption cycle deadline may have passed and the original program is often in need of updating – especially in the science texts (Baughman, 2008). In order to stave off these time pressures, a *new* textbook is often merely a revision of existing texts with updated terminology reflecting the latest trends in learning theory (House & Taylor, 2003).

There are numerous major publishers of science textbooks alone (Herr, 2007), but the list is ever-changing due to divisions, mergers, and acquisitions. The current major parent companies include:

- Cengage (Thompson Educational, Brooks Cole, Gale, Wadsworth),
- Houghton Mifflin (Harcourt Brace, Holt, Rinehart, Winston, McDougal Littell),
- Kendall Hunt Publishing Company,
- McGraw Hill (Macmillan, Glencoe), and
- Pearson Curriculum Group (Prentice Hall, Scott Foresman, Silver Burdett Ginn,

Addison Wesley, Allen and Bacon, Benjamin Cummings).

The websites of these major players in the publishing business tout such accolades as *nation's leading educational publisher, accuracy, integrity, high quality, and academic excellence*. To maintain their viability in the marketplace, these companies must prove somehow they are better than their competition.

Ample criticism of secular-published science textbooks can be found throughout educational literature and from a variety of sources. The criticisms arise from professional organizations as well as educators and focus on issues of scientific accuracy, academic rigor, visual format, and bias. A plethora of scientific inaccuracies, such as the errant interchange of the terms speed/velocity/acceleration or hypothesis/theory, incorrect unit labels, contradictions in timelines, and incorrectly drawn graphs and charts plague many science texts (French, 2006; Hubisz, 2003; Summers, Decker, & Barrow, 2007). Other criticisms charge that the process of science, including science as a way of thinking and investigating, is distorted, naïve, and unbalanced in many science textbooks (Hoff, 2000; Lee, 2008; Phillips, 2006).

Some sources have attributed the lower standardized test scores prevalent in the 1990s to the lack of academic rigor in high school textbooks. The trend toward lower reading levels, shortened and simplified sentence structures and the elimination of unusual words, however, has been traced as far back as the late 1940s (Hayes, Wolfer, & Wolfe, 1996). The president of the Textbook League was so bold as to write,

Dumb teachers demand dumb textbooks, and all of the major educational publishers have produced books that such teachers will buy – books in which factoids substitute for concepts, slogans substitute for explanations, and pedagogy

is often reduced to inane gimmicks which look like didactic devices but which, in fact, don't require teachers or students to know anything or learn anything. These pseudopedagogic gimmicks include questions and exercises which impel students to bray opinions about matters that they don't understand, to specify 'solutions' to problems that lie far beyond their comprehensions, or to vent their juvenile emotions as if emotions were equivalent to knowledge (Bennetta, 2000, ¶ 1).

Reviewers, focus groups, and special interests promote their own agendas, crying bias on the part of the other. Too many topics, too few topics, too many vocabulary words, too little depth, and too much emphasis on one topic while slighting another are some of the objections of textbook evaluators. Islamic propaganda was cited by Gettelman (2008) as bias in a social studies textbook, and Diane Ravitch's often-heard cries of censorship hone in on the perceived necessity for textbooks to be free of gender-specific terminology, ethnic and professional stereotypes, politically incorrect vocabulary, and any influence from religious groups (Ravitch, 2003; Seligman, 2003). Ravitch, author of *The Language Police* (Ravitch, 2004) and guru of political correctness in education, is determined that students not be exposed to anything or anyone offensive. Some reviewers, however, see this as a dilution of content and a degradation of genre (Westwater, n. d.). With the focus on winning a slice of the market share, the publishers are accused of catering to various political and cultural pressures while eliminating the competition by buying out each other (Galloway, 2006a; Galloway, 2006b). The publishers are willing to provide whatever the market will purchase (Bradley, 1999; Hoff, 2000; Lee, 2008; Phillips, 2006). In order to please the client, the resulting textbooks may omit objectionable chapters or add disclaimers to texts destined for major adoption states

(Witham, 1997).

A major initiative by the AAAS (American Association for the Advancement of Science, 2000) focuses specifically on educational reform in science education. The detailed appraisal of ten high school biology textbooks, using two dozen specific criteria addressing four major topics in biology, highlighted serious deficiencies. None of the books was rated high in either subject content or design, citing piecemeal and fragmented presentations of significant topics with lavish illustrations of little scientific depth and focusing on the trivial.

Christian educational groups are also aware of the typographical errors, scientific inaccuracies, and overall poor quality of secular textbooks, and they often make their voice heard. The Texas conservative Christian watchdog group, Educational Research Analysts, was founded over 60 years ago by Mel and Norma Gabler. The mission of this group is to let the conservative Christian voice be heard through textbooks reviews. Currently led by Neal Frey, this group makes available detailed reviews of secular textbooks in all of the above-mentioned areas in addition to blatant anti-Christian biases (Educational Research Analysts, 2007). Conversely, the Textbook League which demands censorship of politically incorrect terms in textbooks accuses conservative religious organizations of attempting to advance their religious propaganda through myths, superstitions and lies for the purposes of indoctrination and recruitment (Bennetta, 2003). The contradictions seem obvious. One teacher was quoted as saying, “Now [creationism] muddies the waters and keeps students from having a really good education. When they go to college, they will be at a disadvantage because they will not have a good understanding of science” (Bathiji, 2008, ¶ 4). A more liberal education

which investigates all sides of an issue would seem to be the better education. Logic leads to the conclusion that the student with the disadvantage is the one who is taught only one interpretation of an issue (Nord, 1999).

The concern of conservative Christians, however, goes beyond the popular confrontations regarding evolution/creation/intelligent design or the misrepresentations of historical events. The objections center on blatant anti-Christian biases in public school textbooks. Content errors can be corrected through effective editing, but the teaching of an anti-God worldview in public education is unacceptable for many Christians. Textbooks free from the influences of politics, liberal philosophies, and beliefs which contradict conservative values, yet promote literacy and appreciation for the created world, are those most valued (Chapman, 2007; Galloway, 2007).

Michael Chapman (2007) categorized secular textbook biases into three categories, each aimed at the rejection of any reference to biblical Christianity:

1. Censorship of America's Christian heritage, particularly in history textbooks, by omitting historical references to the prayers and faith of our Founding Fathers, or the significant influence of the Judeo-Christian ethic in America.
2. Association of Christian ideals with negative groups or events such as the KKK, imperialists, and enslavement of the Indians by conquistador missionaries.
3. Contextual redefinition by changing the meaning of the text such as the intent of the writers of the Declaration of Independence, details of Church history and doctrine, and elimination of the influences of Christianity in multicultural studies.

Chapman's perceptions represent a reiteration of what had been voiced a decade and a half earlier when world civilization textbooks were examined: "The Christian worldview

was either missing or sadly neglected, and the type of family life, morals and government encouraged by principles was denigrated” (Snyder, 1993, ¶ 12). Textbooks should not be based on someone’s ideology but on the truth. The question becomes ‘Whose truth?’ (Cavanagh, 2005).

Christian-published Textbooks

The secular educational community acknowledges a textbook selection process based on ”choosing curriculum materials that most closely match the ideal teaching and learning process envisioned for your school” (House & Taylor, 2003, p. 538). “To be fair and objective, schools must concentrate on their fundamental mission of teaching and learning (“Defining the Debate,” 2001, p. 56). This is exactly what Christian education is trying to accomplish. To serve the growing sector of the educational market which demands school choice and seeks high quality curriculum materials which align with conservative values, early Christian publishing companies pledged to provide textbooks and ancillaries which meet the prerequisites of content accuracy, academic rigor, pleasing format, and beliefs and values matching the conservative Christian community, while at the same time nurturing the growth of the whole child and fueling the growth of many private religious schools (Davis, 1990).

Early research involving Christian publishing companies indicated religious factors as the primary criteria in the development of their products, along with moral tone and excellence in academics and literary (Bowling, 1996). Interestingly, of the 42 Christian companies involved in Bowling’s study, more than 50% of them identified the following topics as valuable when determining subject matter for inclusion in their products: a non-Christian worldview, secular classics, women in non-traditional roles,

myths/fairytales/legends/modern fantasies, and racial and cultural diversity. Subjects excluded by most of the published textbooks were science fiction, evolutionary presuppositions, non-traditional family structures, homosexual content, anti-social or abusive behaviors, coarse language, and depictions of sexual activities. This analytical assessment parallels the stated mission and goals of many Christian publishing companies: Adherence to the inerrancy of the Bible as authoritative truth, the unity of God the Father, Jesus Christ the Son, and the Holy Spirit, the creation of man in God's image, possessing an eternal soul, the subsequent fall through disobedience, and the restoration of fellowship with the Father through faith in the substitutionary sacrifice of Jesus Christ. These are the tenants which identify textbook publishers as Christian.

During the last three decades, the religious publishing market in the United States has grown into a 7.5 billion dollar business, driven in part by the conservative Christian community (Marketresearch.com, 2006). Of the hundreds of publishers, there are almost 60 companies which serve conservative Christians with religious magazines, devotionals, fiction and nonfiction, hymnals, and biographies. Thomas Nelson, Zondervan, Tyndale House, and Baker Publishing Companies comprise over 60% of this market share (Hyatt, 2007; Wikipedia, The Free Encyclopedia, 2007). Dozens of smaller Christian publishing companies serve the home school community with custom curricular materials. Of the companies which service Christian day schools, six are most prominent: A Beka Books, Accelerated Christian Education, Alpha Omega Publications, Apologia Educational Ministries, Bob Jones University Press, and Christian Liberty Press. Each envisions its God-given ministry to Christian schools as setting the standard of excellence in providing high quality textbooks and teaching aids, enabling schools to fulfill their biblical

education mandate.

A Beka Books

Founded in 1953, A Beka Books is the oldest of the Christian school textbook publishers. An outgrowth of Pensacola Christian College and Pensacola Christian Academy, A Beka Books provides textbooks in the core curriculum subject areas for nursery through 12th grade, in addition to training seminars, clinics, and graduate programs for educators. The textbooks offer a Christian traditional approach to education. Central in all subjects is the Bible which becomes the foundation for all learning. The science textbooks are non-evolutionary in philosophy and build abstract concepts upon the students' prior knowledge, showing the harmony between true science and faith (A Beka Books, 2008).

Research on aspects of the A Beka curriculum is scant. The most recent studies investigated different aspects of the elementary curriculum. Griffin (2003) examined the mathematics and reading curriculum used with supplementary materials in urban classrooms. Her findings indicated the curriculum was aligned with the standards set by the Association of Christian Schools International and deemed appropriate for students in Kindergarten through grade 2. Osborn's (2006) results were not as positive when examining pictures and linguistic representations of cultural diversity in the A Beka history curriculum used for Kindergarten through grade 6. According to the author, the evaluation of the textbook indicated a fundamentalist stance which teaches American elitism, an *us-them* mentality, and the assimilation of the individual into the norms of the community. Osborn's conclusions could be interpreted as an attempt to expose politically incorrect vocabulary in the textbooks.

Accelerated Christian Education (ACE)

Founded in Texas in the early 1970s, the ACE curriculum was established on high biblical and academic standards with the goal of preparing students academically and spiritually to reach their potential. The materials, designed for preschool through high school, are individualized and self-paced. Students work independently in consumable workbooks called PACEs, the successful completion of which allows promotion to the next level of workbooks (Accelerated Christian Education, 2008). Ideal for the early conservative Christian home schools, this format enabled families to provide a Christian education to a variety of grade-level children simultaneously, at a low cost, and with little teaching experience required on the part of the supervising adult (Poyntz, 1994).

The greatest abundance of research literature surrounding Christian-published curriculum materials has been in regard to the ACE programs. The earliest of these dates back to 1980 during which time the dissatisfaction of many conservative families with public school education resulted in a surge in the growth of Christian home schools and day schools. The availability and low cost of ACE curriculum materials met the growing need for an alternative approach in the education of their children (Stoker & Splawn, 1980). Askew (1998) disagreed, concluding the ACE curriculum was not a strong factor driving parents toward Christian education as much as the individualized attention their children would receive in a Christian school environment, an escape from the peer issues found in the public school setting, and other reasons dealing with values and philosophy. Either way, ACE was ready to step in to provide accessible materials which could be used at home or in the Christian day school.

Research involving the ACE curriculum and student achievement yields divergent

results. The personalized instructional format and the readability of the ACE curriculum was found to be equal or superior to the traditional lecture methods of instruction when measuring student achievement, although it was insufficient in preparing students for college-level studies as measured by SAT scores (McDermid, 1980). A longitudinal study conducted by Mowrer (1981) added that it was not the program itself which was effective as much as the number of modules completed in reading, language, and mathematics which predicted student achievement.

Other studies offered evidence of the negative effect of the ACE curriculum on student achievement. Although there were variations among individual subject area scores, Kelley (2005) found the composite ACT scores of ACE graduates to be consistently lower than those of public school students. Kelley additionally noted there was no significant difference in the scores of students using the ACE curriculum on the ACT Science portion of the test. She hypothesized that this higher score for science may have been due to the greater emphasis on creationism in the ACE program fostering reasoning skills necessary to do well on this portion of the ACT.

When comparing ACE graduates, traditional Christian school graduates and public school graduates with their college freshman-year GPAs, Allison (1982) found no significant difference between the three groups. He did note, however, a significantly higher college GPA for public school students in the second semester of the freshman year. Three years later in a similar study Pantana (1985) also found no significant difference when comparing college GPAs and SAT/ACT scores with the type of high school from which students graduated. Family background and home environment were shown to have a greater impact on student achievement than did the curriculum used in

high school.

Alpha Omega Publications

Headquartered in Iowa, Alpha Omega Publications (AOP) promises quality Christian curriculum products, quality service, and reliable support. Serving the home-school and Christian day school communities since 1977, AOP's brands are used in all 50 states and 30 countries, and range from online curricula for grades 7 through 12 to traditional textbooks for classroom use. The high school science texts emphasize observation, experimentation and the scientific method (Alpha Omega Publications, 2007). No research has been found involving Alpha Omega curriculum products or any response received to email inquiries from this researcher.

Apologia Educational Ministries

Founded in the mid 1990s by Dr. Jay Wile, Apologia Educational Ministries provides K–12 resources for the home school community. Although educational materials from other major Christian publishing companies can be found on the Apologia website, Apologia provides creation-based science curriculum materials distinctly designed for home school use. Science titles include introductory through advanced high school biology, chemistry and physics. Some Christian day schools have found Apologia products appropriate for their high school science program (Young, 2008). No research has been found involving the products of Apologia Educational Ministries or any response received to email inquiries from this researcher.

Bob Jones University Press

An affiliate of Bob Jones University in South Carolina, Bob Jones University Press (BJUP) published its first textbook in 1974 in response to the need for quality

educational materials for the growing home school and conservative Christian day school communities. Committed to providing pre K-12 educational materials with a traditional biblical worldview and a strong emphasis on academic standards, BJUP offers curricula, software, distance-learning programs, and testing services for its constituency. Critical thinking, a love for learning, and an ability to apply truth to life are stated as the goals of their comprehensive and educationally sound educational materials. As a special emphasis, BJUP provides additional educational resources through its extensive media and music departments (Bob Jones University Press, 2008a). Unlike the other Christian publishing companies, the sale and marketing of BJUP products and services are conducted through the Precept Marketing Group serving Christian day schools and home schools. Individualized customer service is provided by Precept Marketing representatives for clients using BJUP materials, ACS Technologies, and Rosetta Stone products (Precept Marketing Group, 2008).

Christian Liberty Press

Like the previous publishers, Christian Liberty Press provides Christ-centered, high quality, affordable curriculum materials with a distinctively biblical worldview. Unlike the other publishers, the textbooks offered in the K – 12 core courses may represent Christian Liberty Press publications or a number of other publishers from around the world. Christian Liberty Press, founded in the late 1980s, is associated with the Church of Christian Liberty, Christian Liberty Academy School System, and Whitefield College near Chicago. A distinctive of this publishing company is their inclusion of biographies, culture, and the arts throughout the curriculum (Christian Liberty Press, 2008). No record has been found of any research conducted on Christian

Liberty Press curriculum materials. This absence of any research was confirmed by the organization's Administrative Director, Lars Johnson (Personal communication, March 10, 2009).

Research on Multiple Christian Publishing Companies

Significant research was conducted in the 1980s involving comparisons of the newly established A Beka and ACE publishing companies. One early study compared the individualized self-paced approach of the ACE curriculum to traditional classroom approach of the A Beka curriculum (Eby, 1986). In this study, the mathematics and reading programs in grades two through eight in five Christian schools were investigated and test scores compared to national norms. Although there was considerable variability from grade to grade between A Beka and ACE results, both curricula consistently produced scores above the national norms in reading and mathematics.

Ten years later, the published materials of A Beka, ACE, BJUP, and the Association of Christian Schools International (ACSI) were examined by Givens (1996). Striking similarities were found in the philosophical and theoretical foundations of all four companies. Although the author concludes that these publishers fill only a small niche in the Christian educational community, she does acknowledge the positive emphasis on the selection of materials and the organization of the process of learning. No student achievement results were investigated.

More recently, research projects have been undertaken by BJUP to establish the validity and reliability of their product line. The independent Florida research firm of Jackson/Dawson Marketing conducted an extensive five-year study involving 245 Christian schools, 53,000 students and 493 publishers between 2002 and 2006. The

purpose was to assess the effectiveness of the publishing companies in preparing students for the yearly Stanford and Iowa achievement tests. Results indicated similar scores for users of Christian-published materials in Kindergarten through grade four, but significantly higher scores than those representing secular publishing companies in grades 5 through 11. Schools using BJUP materials consistently scored at or above those representing secular publishing companies. The findings were attributed to the products' emphases on critical thinking skills and intentional paced learning for comprehension (Bob Jones University Press, 2008b). The identities of the secular publishing companies and the other Christian publishing companies were not revealed.

Focus of this Study

Given the decades of research conducted on Christian publishing companies and the often conflicting results, it would seem reasonable to investigate further the impact of Christian-published textbooks on academic achievement in this current research. Understanding the mission of the publishers and the educational philosophy of each as being congruent with a biblical worldview, the totality of that impact on the ACT science reasoning scores of graduates from Christian day schools is the subject of this current research.

Not all Christian educators are convinced that the best Christian education is obtained through the use of Christian-published textbooks exclusively. Just as there are differing views within the Christian education community regarding enrollment criteria and governorship, there are also differing views on the choice of curriculum materials. Tate (2007) sees the use of secular texts in Christian schools as a tool for engaging students in a dialogue about their faith. Dr. Tate aptly writes,

Although the faith of our students may be immature, it can still be damaged, so we need to find constructive ways to deal with students who are unpracticed at or even resistant to philosophical reflection about Christianity. Mature faith requires reflection on faith itself. We are not irrational fideists fearful of exposing our students to arguments for claims that oppose Christianity. Knowing...faith better for having glimpsed it from the outside...provides a crucial component of liberal education. An education aims to encourage mature reflection on and [an] understanding of the faith itself (Tate, 2007, p. 30).

Closson (2008) tempers this approach by cautioning:

The younger children are, the more vital it is that we give them an uncompromised Christian perspective. As they grow older and can understand more complex or abstract issues it becomes important to introduce them to other worldviews. The point is that when students are mature enough they should encounter difficult ideas under the direction of capable Christian instructors.... Merely offering students a diverse view of the world does not appear to me to be a legitimate goal of Christian education. Introducing students to various perspectives in order to evaluate them in the light of revealed truth and to become more effective ambassadors of God's kingdom might be more appropriate (§ 1, 4).

The Christian Scholar's Review (Hull, 2003) published an article encouraging Christian educators to learn from the experiences of public school reformers. The Director of Development of a large Midwest Christian day school, Dr. Kenneth Hall, agrees that the Christian school community need not "re-invent the wheel" (Personal communication, April 10, 2008). Taking what is useful, effective, and true from the

public sector is time- and cost-effective, and that includes utilizing much of the research done in the area of curriculum materials. Capehart (2000) maintains it is the people that make the program Christian, not the curriculum used. Whether the curriculum originates from an evangelical publishing house or from a secular company, it is transformed into a Christian curriculum by the teacher. Curriculum materials which present a wide array of viewpoints and details can be used to teach students to react and respond in ways which build individual responsibility and solidify a biblical worldview (Holtrop, 1996).

Other sectors of the Christian education community are not as accepting of the public school paradigm used in the Christian school setting. In the book, *Recovering the Lost Tools of Learning*, Wilson (1991) argues that the secular curriculum distorts the truth when it attempts to rewrite history, and the only curriculum which is viable for a Christian school is one which is rooted in scripture. Research conducted by Poyntz (1994) encourages conservative Christian schools to utilize curricular materials exclusively from Christian publishing companies because the national curriculum is secular and humanistic. The distinctively Christian curriculum “cannot be reduced to a list of subjects, to a philosophy statement, [or the] scope and sequence of a textbook” (Auty, 2007, p. 28), nor can it embrace liberalism in any form (Pike, 2004). The failure on the part of Christian schools to produce a distinctively different school model signifies the absence of a truly biblical Christian education (Hull, 2003).

Summary

From this discussion of whether to select Christian-published or secular-published science curricular materials emerges this current research. Confirmation that the Christian approach to education is effective is seen in the school’s ability to successfully prepare

students for higher education. The primary factor to be examined is whether there is a difference in the ACT Science Reasoning scores of students as to whether Christian-published or secular-published textbooks were used in the required high school science courses. The ACT has been established as a viable tool for assessing the effectiveness of that preparedness. Even though the ACT test was embraced by many researchers interested in evaluating curriculum materials produced by numerous, newly-established, Christian publishing companies, the conflicting results of Allison (1982), Kelley, (2005), Pantana (1985), and Verhaalen (2005) leave the primary question of this current study unanswered.

The rise of conservative Christian day schools and their subsequent recognition by the United States government in serving a significant sector of the school population in the United States has established their legitimate place in educational research. Rooted in the guiding principles of scripture, a Christian philosophy of education addresses the soul, mind, and heart of children. Within the Christian education community, there is much discussion as to the use of Christian-published curriculum materials as opposed to materials published by secular companies. The intent of this current research is to address the effectiveness of Christian-published science textbooks in preparing Christian high school students for success in college as measured by their ACT Science Reasoning score.

Much research has been conducted on the ACT test and its usefulness in predicting success in college and in measuring school effectiveness. Research can be found on Christian school effectiveness, science classroom curricular options, and various publishing companies. Much less research is available, however, on the direct

relationship between college preparedness as measured by the ACT test and the type of textbook publishers used for classroom instruction. The purpose of this current research is to investigate the relationship between the ACT Science Reasoning scores of Christian high school students and the type of textbook publisher used in the science courses.

CHAPTER THREE: METHODOLOGY

General Perspective

Although students' college preparedness is a multi-faceted construct influenced by many factors, universities rely on college entrance examinations to compare applicants equitably from a myriad of academic backgrounds across the world and predict their success in the college environment. The current research examined college preparedness in the area of science as measured by the Science Reasoning component of the ACT test and traced those scores back to the publisher of the classroom curriculum used throughout the students' high school science experience. The goal was to determine if a significant statistical difference exists between the 2008 ACT Science Reasoning scores of Christian high schools using Christian-published science textbooks as compared to those using secular-published textbooks.

This research utilized a combination of causal, correlational, and survey design was chosen because there was no manipulation of the pre-existing variables or randomization of subjects. The dichotomous discrete independent variables were represented by the category of publisher used in the Christian high school science curriculum, whether Christian or secular. The research assessed the effectiveness of that category of publisher in preparing students for college science courses as measured by the ACT Science Reasoning subtest scores (the dependent variable). Information regarding both the independent and dependent variables was obtained through a questionnaire.

Research Context

The data for this investigation were gathered during the spring semester, 2009, from Christian high schools affiliated with or holding membership in the American Association of Christian Schools (AACS), Association of Christian Schools International (ACSI), and Oral Roberts University Educational fellowship (ORUEF) located in the Midwest states of Illinois, Indiana, Michigan, Ohio, and Wisconsin. Both urban and rural schools of varying enrollments were represented. A survey requesting the pertinent data was mailed to the chairpersons of the science departments of the target schools.

Research Question

Is there a difference in the scores on the Science Reasoning subtest of the American College Testing (ACT) college entrance examination of Christian high schools which use Christian-published science textbooks as compared to the scores of Christian high schools which use secular-published science textbooks?

The Research Subjects

The Christian high schools selected for inclusion in this research are located in the five Midwest states and are affiliated with or hold membership in the government-recognized conservative Christian school organizations of AACS, ACSI, and ORUEF. These schools number almost 6,000 nation-wide with over 500 K-12 schools represented in the five target states (National Center for Education Statistics, 2007b). Although the government also recognizes schools associated with Accelerated Christian Education as 'conservative Christian,' ACE schools do not use traditional textbooks for group instructional purposes and were eliminated from this current study.

Each of the organizations from which the samples were drawn offers

opportunities for teacher certification, school accreditation, training in the Christian philosophy of education, and various professional development opportunities. As a result of these programs, the decision to select schools from these organizations contributed a measure of control of some of the extraneous variables.

A database of schools located in the five Midwest states was developed from the organizations' websites (American Association of Christian Schools, 2008; Association of Christian Schools International, 2008; Oral Roberts University Educational Fellowship, 2008). Of these schools, those serving grades 9 through 12 represented the population of interest. The subjects of interest consisted of schools with a 2008 graduating class who had taken the ACT college entrance examination and had experienced instruction using science textbooks during their high school science education. A paper/pencil questionnaire was sent to each school for the purposes of collecting school data, science program data, ACT Science Reasoning scores and specific information regarding the textbook publishers used.

Instruments Used in Data Collection

It is the policy of the ACT not to publish the scores for any individual students, schools, or school type (Richard Phelps, personal communication, July 8, 2008), and, therefore, it was the task of this researcher to collect the ACT Science Reasoning scores from the individual schools participating in this study. A questionnaire (Appendix A) was developed for the purpose of collecting additional information regarding:

- size and age of the school 9 - 12,
- number of students in the graduating class of 2008,
- number and kinds of science courses required for graduation,

- number of full-time and part-time teachers and their level of certification,
- number of laboratory experiences per month,
- evaluation of the science facilities, and
- the specific textbook publishers used.

The last item on the questionnaire was an open-ended question inquiring as to the reason why the school chooses to use secular- as opposed to Christian-published textbooks (or *vice versa*) for its high school science curriculum. The responses were coded, categories appeared, and themes suggesting why a particular type of publisher is used in the school became evident.

Arising subsequent to this current study were answers to the following questions:

1. Are there Christian high schools which choose not to use any published textbooks for their required high school science courses?
2. Which are the most commonly-used publishers of science textbooks for Christian high schools?
3. Are there certain Christian publishing companies which are more effective than others in preparing students for the Science Reasoning subtest of the ACT?
4. What percentage of the Christian high schools sampled offer science courses beyond those required for graduation?
5. What percentage of the Christian high schools sampled offer Advanced Placement science courses?
6. Do the additional items of information collected from each school indicate any trends in science education in Christian schools?

7. What are the major reasons why a Christian high school would choose Christian-published science textbooks over secular-published textbooks, or vice versa?

Face validity of the questionnaire was addressed via field testing conducted by the researcher. Ambiguities, misunderstandings, or other inadequacies in the questionnaire were corrected through a field test involving a statistics consultant, language editor, and three administrators. The questionnaire was further tested by simultaneous administration to three local high school science teachers. Careful attention was given to comments on clarity, format, interpretation of the questions' intent, and time for completion. Results of the field tests appear in Appendix B.

A response rate of 50% was expected, with a follow-up letter and questionnaire sent to those schools from which no response was received. Responses to the majority of the items on the questionnaire were empirical, with little opportunity to provide erroneous or subjective responses. This improved the reliability of the instrument and allowed objective tabulation of the responses. Once the data were tabulated, internal consistency measures of reliability became more apparent.

A letter of introduction and purpose (Appendix C) was drafted which introduced the respondents to the researcher, the purpose of the research and the questionnaire, requested their participation, and assured confidentiality and anonymity. Instructions for completing the survey, along with the estimated time for completion, were also stated. It was requested that the questionnaires be completed and returned within two weeks.

Enclosed with the letter of introduction and data-gathering questionnaire was a self-addressed, stamped return envelope. Each return envelope was numbered for follow-

up purposes and marked with a box to be checked if a summary of the results was requested. The letter of introduction, questionnaire, and return envelopes were addressed to the high school science department chairpersons of the high schools in the five Midwest states associated with AACCS, ACSI and ORUEF.

To protect the rights and welfare of the participants in this study and to confirm the appropriateness of the procedure, a copy of the research proposal, cover letter, and questionnaire were submitted along with the required forms to the Liberty University Institutional Review Board for approval (Appendix D). Since the project involved minimal risk to the participants, no individual student ACT scores would be collected, and the schools would remain anonymous in the reporting of the results, a *research exemption* status was approved (Appendix E).

Procedures

With the cover letter and questionnaire prepared and the database of Midwest schools amassed, the envelopes were addressed to the science department chairpersons and mailed. Upon return of the questionnaires, each school requesting that a summary report be mailed during the summer of 2009 was noted on the master spreadsheet and the envelopes discarded to maintain the anonymity of the respondents. After three weeks, follow-up letters and questionnaires were sent to non-respondent schools by way of emails and faxes.

Data Analysis

Schools not meeting the criteria of 1) serving students in grades 9 – 12, 2) using published textbooks in the required science courses, or 3) providing the ACT Science Reasoning subtest scores were self-selected out the study and the questionnaires removed

from the pool of responses. From the remaining schools, responses to each of the questions were entered onto a spreadsheet. The mean score on the ACT Science Reasoning subtest was calculated for all schools making up the sample and compared with the published 2008 national average. The assumption was that the mean ACT Science Reasoning score for the entire sample of schools would be higher than the national average.

The schools were then sorted into two categories: those schools using Christian-published science textbooks exclusively and those using secular-published science textbooks exclusively. The questionnaire provided the information necessary to categorize the schools using a combination of publisher types in their required science classes into either Christian or secular. Since the research assessed the influence of the type of textbook publisher on students' ACT Science Reasoning scores, those schools using Christian textbooks for the majority of the required science courses were included in the Christian-published category, whereas those schools using secular-published textbooks in the majority of the required science courses were included in the secular-published category. If any question arose as a result of combinations of publishers, the final decision was based on the publisher of the biology textbook.

The first level of analysis consisted of descriptive statistics which defined the population parameters of each group. Presented in Chapter 4 are

- measures of central tendency, such as mean, median, and mode,
- measures of variability around the mean, including range of ACT scores, variance and standard deviation,
- frequencies and percentages of the individual publishers used, and

- summaries of additional questionnaire responses.

The statistic of interest was a comparison of the mean scores of the two groups of schools consisting of those using Christian-published science textbooks and those using secular-published textbooks. These mean scores represent μ_1 and μ_2 of the Null Hypothesis which was tested in order to determine the likelihood of the experimental results occurring by chance alone.

$H_0 : | \mu_1 - \mu_2 | = 0$ There will be no difference between the mean ACT Science Reasoning scores of Christian school students who have been instructed using Christian-published science textbooks as compared to those Christian school students who have been instructed using textbooks published by secular publishing companies.

The schools' scores were not weighted by the number of students in the graduating class since the school score was the statistic of interest in this study, not the individual students' scores. The means were compared using the equation for the Null Hypothesis, $H_0: | \mu_1 - \mu_2 | = 0$.

The equation of the Null Hypothesis represents the essence of this current research. The analysis involved a 2-tailed test set at a 95% confidence level and a significance level of $\alpha = 0.05$. Because the two groups were not equal in number, the sampling distribution, standard error, and p -value were the most informative. These, along with the calculation of the equation for the Null Hypothesis, represent the second level of statistical analysis.

The third level of statistical analysis utilized multiple regression to determine if any correlation exists between the ACT Science Reasoning scores and the individual type

of Christian publisher used by the sample schools. Regression analysis did not encompass the secular publishing companies, as this is not the focus of the current study. The results of the regression analysis further elucidate the data in search of any significant difference in the ACT Science Reasoning scores of the sample schools which use one publisher as compared to the other publisher.

Responses to the open-ended question regarding the reason for the schools' choice of Christian- or secular-published textbooks were organized and sorted. The words in the responses were coded in an attempt to identify categories and themes, leading to interpretation and understanding. The purpose in this last level of analysis was to determine if the reasons for selecting Christian-published science texts were consistent throughout the sample. The results of each level of analysis are presented in Chapter 4 with interpretation and discussion of the findings in Chapter 5.

Summary of Methodology

The purpose of this study was to determine whether there is a causal relationship between the type of science textbook publisher used, whether Christian or secular, and the average ACT Science Reasoning scores of Midwest conservative Christian high schools. Information pertaining to the research was gathered by a questionnaire which was mailed to the Christian high schools in five Midwest states. Responses were recorded and analyzed using MEGASTAT™ statistical computer software.

Is there a difference in the scores on the Science Reasoning subtest of the American College Testing (ACT) college entrance examination of Christian high schools which use Christian-published science textbooks as compared to the scores of Christian high schools which use secular-published science textbooks? This research question was

addressed using three levels of statistical analysis: descriptive statistics, test of the Null Hypothesis, and multiple regression analysis. In addition, analysis of the coded responses to the single open-ended question enabled identification of categories and themes. The results of each of these analyses are described and explained in the text as well as presented in the summaries, tables, charts, and graphs of Chapter 4.

The current study contributes new information to the limited body of knowledge regarding the programs and practices of conservative Christian schools and research-based data regarding Christian education, ACT scores, and textbooks. Through examination of the data provided by the study of these previously unexplored phenomena, the results provide insight into the state of science education and college readiness in Midwest Christian high schools.

CHAPTER 4: RESULTS

The research problem, as stated in Chapter 1, addresses whether there is a difference in the mean score on the Science Reasoning subtest of the ACT college entrance examination of Midwest Christian high schools which use Christian-published science textbooks as compared to the mean score of Midwest Christian high schools which use secular-published science textbooks. The results gathered from the questionnaire are presented in Chapter 4 and are organized around the Null Hypothesis:

$H_0 : | \mu_1 - \mu_2 | = 0$ There will be no difference between the mean ACT Science Reasoning scores of Midwest Christian high schools which utilize textbooks published by Christian publishing companies in their required high school science courses as compared to those Midwest Christian high schools which utilize textbooks published by secular publishing companies.

Identification of the research sample, followed by the descriptive statistics, summarizes the data obtained from the questionnaire. Statistical testing of the hypothesis allowed decisions to be made concerning the parameters of the population of Midwest conservative Christian high schools and subsequently led to the acceptance of the Null Hypothesis. Answers to additional questions posed in Chapter 3 became apparent during the reduction of the data, and multiple regression analysis led to further refinement of the relationship between specific Christian publishers and ACT Science Reasoning scores. All mean values are based on the number of responses received. Responses to the single open-ended question (Appendix A, #18) were coded, during which categories emerged and themes were identified. A summary of the data collected concludes this chapter.

The Research Sample

The Christian high schools affiliated with the American Association of Christian Schools, Association of Christian Schools International, and Oral Roberts University Educational Fellowship comprise the population from which the sample schools were selected. Five hundred forty-eight schools were listed on the associations' websites for Illinois, Indiana, Michigan, Ohio, and Wisconsin. Of these 548 schools, 228 schools were determined to be universities, elementary schools, middle schools, schools which had closed, or schools providing out-dated contact information and were subsequently eliminated. Of the remaining 320 schools receiving questionnaires, 128 were returned, representing a 40.0 % return rate. Seventy-four schools, or 57.8% of the 128 returned questionnaires, met the criteria for inclusion in the current study.

Descriptive Statistics

The statistics presented in Table 3 are based on the data provided by the 74 viable questionnaires. The mean age of the sample schools (Question 4) is 30.3 years, reflecting the late 1970s to early 1980s during which period conservative Christian schools experienced rapid growth. In addition, the mean years of teaching experience of 16.2 years does not include two outliers of 40 and 50 years of experience.

Table 3. *Description of the Statistical Sample*

Question Number	Characteristic	Mean	Median	Mode	Range
4	Age of School	30.3 yrs	31	35	6-156
5	Enrollment in Grades 9-12	108 students	60	20	8-656
6	Number of 2008 Graduates	27 students	14	6	1-170
7	Years of science required for graduation	3 years	-	-	2-4
11	Years of Teaching Experience	16.2 years	16.2	20	2-50

The sample schools were also asked to provide information regarding teacher qualifications, the science textbook publishers used, laboratory experiences offered per month, and school science facilities. Table 4 and Figures 1 and 2 summarize these findings. The percentage of part-time science faculty listed for Question 9 of Table 4 includes those teachers who may be part-time employees as well as those whose teaching responsibilities may include subjects other than science or who have administrative duties. The percentage of non-certified or non-licensed science teachers was 21.8%. The most recent data regarding teacher certification in the public schools comes from the 2003-04 Schools and Staffing Survey. According to the national data, 22.6% of public school science teachers are uncertified (National Center for Education Statistics, 2008d).

Table 4. *Summary Data on Teacher Qualifications, Science Facilities, and Science Curriculum*

Question Number	Characteristic	Data Summary
9	Part-time Science Faculty	31.4%
12	Percentage of Non-Certified Science Faculty	21.8%
16	Percentage of Schools Using Christian- and Secular-Published Textbooks	64.9% Christian 35.1% Secular

The respondents were asked to estimate the number of laboratory experiences offered to the students in the biology, chemistry, and physics courses during a one-month period. Figure 1 presents those findings. The data suggest that the most frequent number of laboratory experiences per class per month is two to three, equivalent to one laboratory activity every other week. Respondents were also asked to rate their school's science facilities. Figure 2 indicates the majority of respondents perceive their science facilities to be above average as compared to other Christian schools. The rating of average was intentionally omitted from this Likert-style question to force the respondents to make a thoughtful judgment regarding their own facilities.

Figure 1. *Number of Laboratory Experiences per Month for Three Science Courses*
(Question 10)

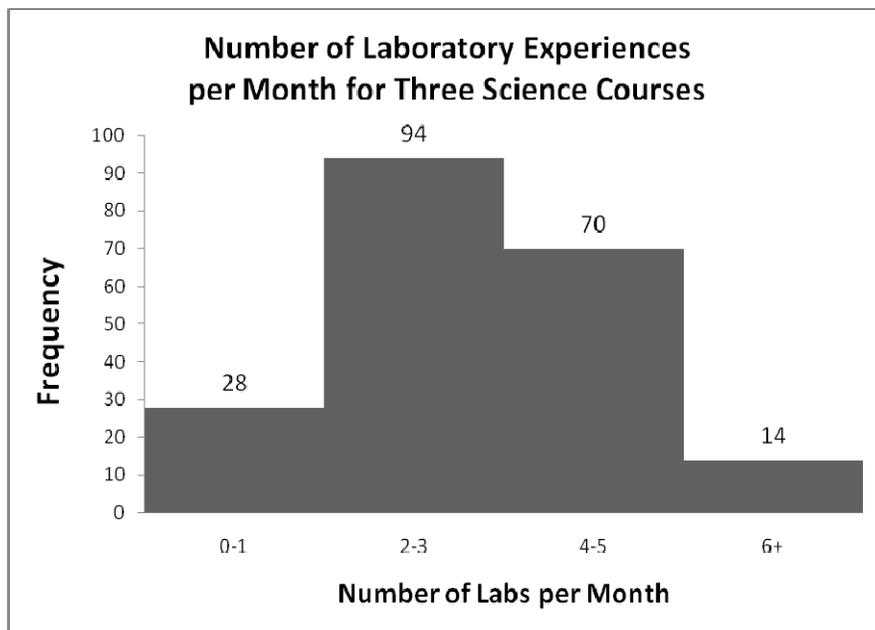
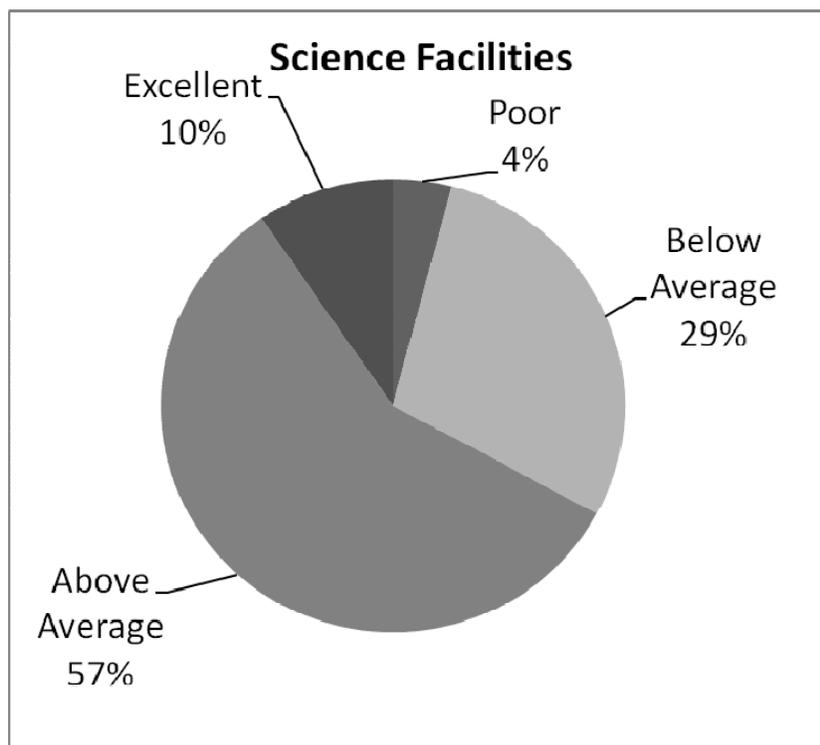


Figure 2. *Evaluation of the School's Science Facilities* (Question 14)



Hypothesis Testing

The Null Hypothesis states there is no significant difference in the mean ACT Science Reasoning scores of the two categories of schools under study: those which use Christian-published science textbooks and those which use secular-published science textbooks. Hypothesis testing provided a way to determine if any difference in the mean ACT Science Reasoning scores of the two groups was statistically significant or due to chance alone. The tests indicate an acceptance of the Null Hypothesis. Table 5 compares the mean national ACT Science Reasoning score to the entire sample of Christian schools, those Christian schools using Christian-published textbook, and those using secular-published textbooks. The data show an above-average ACT score in each category.

Table 5. *Comparison of ACT Science Reasoning Scores (2008)*

Mean ACT Science Reasoning Scores			
National	All Christian Schools Sampled	Christian Schools Using Christian Texts	Christian Schools Using Secular Texts
20.8	22.3	21.9	22.9

A comparison of the mean ACT Science Reasoning scores of the two types of schools in the sample statistic represents the statistic of interest in this study. The results of hypothesis testing calculated on the Null Hypothesis are summarized in Table 6. The results compare the mean ACT Science Reasoning scores and indicate there is no significant difference between the two types of Christian schools. The p -value was calculated to be 0.1063 when $\alpha = 0.05$ indicating an acceptance of the Null Hypothesis:

There is no difference in the ACT Science Reasoning scores of Christian high school using Christian-published science textbooks as compared with the scores of those using secular-published textbooks.

Table 6. *Hypothesis Test: Independent Groups*

Christian	Secular	
21.9323	22.873	Mean
2.9471	1.971	std. dev.
48	26	N

68	df
-0.94079	difference (Christian - Secular)
0.57476	standard error of difference
0	hypothesized difference
-1.64	T
.1063	p-value (two-tailed)

The standard deviations, identifying approximately two-thirds of the scores sampled, fall in overlapping ranges for the two groups of schools: scores ranging from 19.0 to 24.9 for schools using Christian-published textbooks, and scores ranging from 20.9 to 24.8 for schools using secular-published textbooks. The data from the samples do not provide enough evidence to indicate there would be any difference in the mean scores of the two groups within the population of schools.

Additional Findings

It was anticipated that answers to additional questions would become apparent from the data gathered. The questions and their data-based answers are listed below.

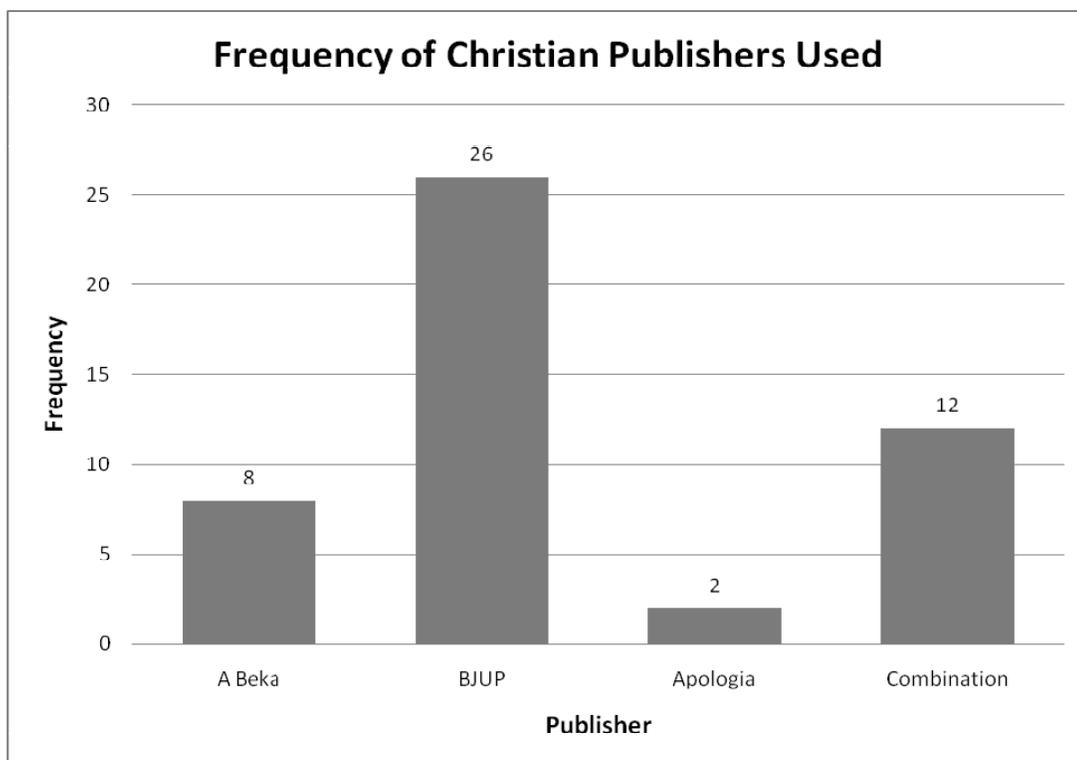
1. *Are there Christian high schools which choose not to use any published textbooks for their required high school science courses?*

Five schools or only 6.7% of the schools sampled indicated they use Accelerated Christian Education (ACE) Paces. These are self-paced consumable workbooks which do not meet the criteria for traditional textbooks as defined in this study.

2. *Which are the most commonly-used Christian publishers of science textbooks for Christian high schools?*

Of the 74 schools responding to the questionnaire, 48, or almost 65%, use science textbooks published by Christian publishing companies. The publishers cited were A Beka Books, Bob Jones University Press, and Apologia Educational Ministries, with no mention of the other major Christian publishers. Figure 3 shows the frequency of each of the three Christian science textbook publishers used exclusively by the sample schools and when used in combination with each other. The data indicate BJUP science textbooks are used in over 50% of the 48 schools sampled which use Christian-published textbooks in their science courses.

Figure 3. *A Comparison of the Frequencies of A Beka-, BJUP-, and Apologia-Published Science Curriculum Materials in the Sample Statistic.*



3. *Are there certain Christian publishing companies which are more effective than others in preparing students for the Science Reasoning subtest of the ACT?*

Regression analysis was used to determine if one Christian publisher is more effective than the other in preparing students for the Science Reasoning portion of the ACT test. The p -value of 0.8841 shown in Table 7 indicates there is no significant difference in the effectiveness of A Beka, BJUP, or a combination of science textbooks in accomplishing the ACT Science Reasoning scores. The Regression Output of Table 7 provides a means by which ACT Science Reasoning scores can be predicted when A Beka and BJUP textbooks are considered independently of each other.

It should be noted that the average ACT Science Reasoning score for the sample schools using textbooks published by Apologia Educational Ministries, exclusively, is 20.5 and is based on only two schools. Such results would not be representative of the population due to the small sample size and, therefore, are not included in the regression analysis in Table 7.

Table 7. *Regression Analysis of ACT Science Reasoning Scores and Publisher Used*

Regression Analysis								
	R ²	0.005						
	Adjusted							
	R ²	0.000	n	48				
	R	0.074	k	2				
	Std. Error	3.001	Dep. Var.	ACT score				
ANOVA table								
Source	SS	df	MS	F	p-value			
Regression	2.2252	2	1.1126	0.12	.8841			
Residual	405.3815	45	9.0085					
Total	407.6067	47						
Regression output								
Variables	coefficients	std. error	t (df=45)	p-value	confidence interval		std. coeff.	VIF
Intercept	21.4707	1.2095	17.752	5.99E-22	19.0347	23.9067	0.000	
A Beka	0.0914	0.9807	0.093	.9262	-1.8839	2.0666	0.015	1.246
BJUP	0.5508	1.1504	0.479	.6344	-1.7662	2.8678	0.079	1.246

4. *What percentage of the Christian high schools sampled offer science courses beyond those required for graduation?*

All schools sampled offer at least one science course beyond those required for graduation. All schools sampled identified biology as one of the courses required for

graduation, with the other requirements fulfilled through a combination of science offerings including anatomy, ChemCom, chemistry, conceptual physics, earth science, environmental science/ecology, food science, integrated science, physical science, or physics.

5. *What percentage of the Christian high schools sampled offer Advanced Placement science courses?*

Twenty-one of the 74, or 28.4% of the schools sampled, offer at least one AP Science, usually biology. Other AP courses offered include AP Physics and AP Chemistry. Many of the advanced science classes offered were designated as honors classes and not necessarily as AP.

6. *Do the additional items of information collected from each school indicate any trends in science education in Christian schools?*

From the sample statistics, the typical Midwest Christian high school is doing well in the area of science education achievement. The teachers are experienced, certified, and conducting laboratory activities in above-average science facilities. The national average on the Science Reasoning portion of the ACT college entrance examination in 2008 was 20.8 and for the five states included in the study, 21.2 (National Center for Education Statistics, 2008f). The ACT Science Reasoning subtest score for the schools included in this study is 22.3, a full 1.5 points above the national average and 1.1 points above the five-state average.

7. *What are the major reasons why a Christian high school would choose Christian-published science textbooks over secular-published textbooks, or vice versa?*

Item 18 of the questionnaire (Appendix A) asked the respondents to cite the major

reason why their school uses the type of textbook publisher it does, whether Christian or secular. The responses were sorted into those from schools using Christian-published texts and those from schools using secular-published texts. The comments from each group were coded and the same two major categories arose for each group: positive comments supporting the school's choice and negative comments refuting the use of the opposite publisher-type. This pattern of positive and negative statements enabled pre-assigned categories to be developed. Appendix F lists several examples of the more common codes used by the respondents, sorted into the appropriate pre-defined categories.

Examination of the codes and categories revealed themes. The vast majority of reasons why some schools use Christian-published science textbooks focus on themes of biblical worldview instruction, including grounding students in creationism, countering evolution, and aligning instruction with the philosophy and mission of the school. The single theme revealed from the codes for reasons why these schools do not use secular-published texts paralleled the positively-stated themes, merely stated in the negative: Secular texts do not provide a biblical worldview, do not advocate creationism, or do not discuss the flaws in evolutionary theory.

The reasons why the other schools use secular-published science textbooks are more divergent, but centered on themes concerning the depth or rigor of subject content. Several respondents mentioned the ancillaries available to the teacher from secular publishing companies, the opportunities to incorporate technologies into their teaching, and the quality of the graphics and illustrations. Similarly, themes for not

using Christian-published texts were expressed as a lack of content rigor, weak practice problems, and poor quality of the published texts. The exclusion of any presentation of other worldview interpretations at the high school level was viewed as a distinct weakness in Christian-published textbooks. Some respondents who use secular texts made strong statements regarding the teacher being the key source of worldview instruction and of a Christian perspective on science. Many of the codes provided by both groups were vague and unexplained, such as “quality,” “better,” and “good,” and were difficult to interpret as to their intended meanings.

Summary of Results

Chapter 4 has provided a detailed summary of the results of the current study. The data presented defines the statistical sample: The typical Midwest conservative Christian high school has been in existence for 30 years and services approximately 100 students evenly distributed in grades 9 through 12. The science department consists of one or two career science teachers with 16 years of experience, providing two to three laboratory experiences per month for each science class taught. Seventy-five percent of the science teachers are full-time and hold credentials from various organizations. The Christian school typically uses Christian-published science textbooks, either A Beka or BJUP, in their required science courses and offers additional courses beyond those required for graduation. Chapter 5 interprets and discusses these findings in greater detail and relates them to current theory, research, and practice.

CHAPTER 5: SUMMARY AND DISCUSSION

The research topic under consideration in this study concerns the type of curriculum used in the required science classes of Midwest Christian high schools. The purpose was to determine if the type of publisher of the high school science textbooks, whether Christian or secular, would make a difference in preparing Christian school students for the Science Reasoning subtest of the ACT college entrance examination. The sample statistics indicate a p-value of 0.1063 set at $\alpha = 0.05$, therefore accepting the Null Hypothesis:

$H_0 : | \mu_1 - \mu_2 | = 0$ There will be no difference between the mean ACT Science Reasoning scores of Christian high schools which utilize textbooks published by Christian publishing companies in their required high school science courses as compared to those Christian high schools which utilize textbooks published by secular publishing companies.

The remainder of Chapter 5 reviews the methodology and discusses the results detailed in Chapter 4. A discourse follows which provides insight and interpretation of the findings in the light of previous research and a Christian philosophy of education. The chapter concludes with recommendations for Christian educators and suggestions for further research.

Review of Methodology

This research employed a combination of causal, correlational, and survey design. As stated in Chapter 3, the data were gathered from Christian high schools located in the

Midwest states of Illinois, Indiana, Michigan, Ohio, and Wisconsin which are affiliated with the American Association of Christian Schools, Association of Christian Schools International, and Oral Roberts University Educational Fellowship. The Cover Letter (Appendix C) and Questionnaire (Appendix A) were sent by mail in January, 2009, and follow-up contacts were made on non-respondents.

The Questionnaire sought information regarding the school, the teachers, the students, the science program, and the science facilities for descriptive purposes. The most significant items of information requested were the school's score for the Class of 2008 on the Science Reasoning subtest of the ACT college entrance examination and whether the school uses Christian-published science textbooks or secular textbooks in the required science courses. An opportunity was provided for the respondents to identify the name of the textbook publishers used. One open-ended question asked the respondents to cite the major reason why the school chooses to use the type of textbook publisher it does.

A total of 228 of the original 548 schools listed on the websites were excluded from the study because they were identified as universities, elementary or middle schools, were no longer in existence, or whose contact information was unavailable or out-dated. Of the remaining 320 schools, 128 questionnaires were returned, representing a return rate of 40%. Upon receipt, any additional questionnaires not meeting the required criteria for inclusion in this study were eliminated. Seventy-four schools met the requirements for inclusion and their responses were recorded. Descriptive statistics were then used as the first level of analysis to define the parameters of the population. The schools were further sorted into two groups: those which use Christian-published science textbooks and those

which use secular-published science textbooks. Christian high schools using Christian-published science textbooks outnumbered the schools using secular-published textbooks by a ratio of 48:26, or almost 2:1. The mean ACT Science Reasoning score was then calculated on the entire sample, on those schools using Christian-published texts, and those using secular-published texts. These mean scores were then compared to the national average (Table 5). The research literature stating that conservative Christian schools earn higher scores on standardized tests than their public school counterparts (Council for American Private Education, 2008; National Center for Education Statistics, 2006) seems to be supported by this current research. A second level of statistical analysis, Hypothesis Testing, was applied to the mean scores of the two individual groups at a significance level of $\alpha = 0.05$ and provided a p -value of 0.1063 with a standard error of difference of 0.57476 (Table 6). There appears to be no significant difference between the ACT Science Reasoning subtest scores of Christian school which use Christian-published science textbooks as compared to those which use secular-published texts.

A third level of statistical analysis involving multiple regression was applied to the data to determine any correlations between the ACT Science Reasoning scores and the individual Christian publishing companies used by the sample schools, specifically A Beka Books and BJUP. Regression analysis indicated there was no significant difference in ACT Science Reasoning scores of those schools using one type of textbook publisher or the other (Table 7). The final level of analysis consisted of coding and analyzing the responses to the open-ended question. Categories and themes became evident, leading to worldview instruction and academic rigor as the deciding factors for the use of one type of publisher over the other. After these analyses of the sample statistics, an image of the

science program in Midwest conservative Christian high schools emerged.

Summary of Findings

This study was intended to demonstrate the relationship between two phenomena: the science curriculum of Midwest Christian schools and ACT Science Reasoning scores. The sample descriptive statistics provide a sketch of typical Christian schools in the five Midwest states included in this study and address the school itself, the science teachers, and the science program.

The Schools

Based on the sample statistics, the typical Midwest Christian high school is approximately 30 years old, houses 100 students, fairly evenly distributed among grades 9 through 12. The science facilities are perceived to be above average in comparison to other Christian schools.

The Teachers

The science department of these Midwest Christian high schools consists of one or two career teachers with an average of 16 years of teaching experience. Almost 70% of these teachers are full-time science teachers and almost 80% are certified or licensed either through national, state, or professional organizations.

The Science Program

Typically, three years of science is required for graduation according to the sample data. Biology is one of the required science courses with the other science requirements fulfilled through a variety of options including physical science, chemistry, physics, and additional biology course offerings. In addition,

- the school offers at least one science course beyond those required for graduation,

most commonly anatomy,

- Advanced Placement courses in biology, chemistry and/or physics are offered by 21 of the 74 schools, representing 28.4% of the schools sampled,
- students participate in two to three laboratory experiences per month in each of the biology, chemistry, and physics classes,
- 65% of the schools use Christian-published science textbooks, and
- of those schools using Christian-published science textbooks, 54% use texts published by BJUP, 17% use A Beka textbooks, and 25% use a combination of the two publishers.

The average ACT Science Reasoning subtest score in 2008 was 22.3, 1.5 points above the national average and 1.1 points above the five-state average.

Insights and Interpretations

The description given above is commendable and appears to be more favorable than the data available for the public schools. Contrary to the conclusions of some researchers (Japinga & DeMoor, 2003; Kelley, 2005; Osborn, 2006; Verhaalen, 2007), the education received by students attending conservative Christian high school in the Midwest is not inferior. According to this study, students are being taught by experienced, licensed, full-time science teachers in above-average science classrooms, and the ACT Science Reasoning subtest scores validate this achievement. The purpose of this study was not to determine, necessarily, why the Christian school ACT Science Reasoning scores are higher than the national average, but to investigate if there is a difference in the mean ACT scores of schools using Christian-published science textbooks as compared to secular-published texts.

The test of the Null Hypothesis seems to indicate there is no significant difference in ACT Science Reasoning scores of Christian schools regardless of the type of science textbook publisher used. Why, then, is there the discussion within the Christian education community as to one approach being more effective than the other in teaching science and preparing the students for the academic challenges of college? Insight into the answer to this question lies in the responses to Question 18 of the questionnaire (Appendix A), inquiring as to *why* the schools choose to use one publisher-type over the other (Appendix F).

After coding the responses to this question, two categories of reasons appeared: reasons in favor of the use of one particular type of publisher and reasons against the use of the opposite type of publisher. As stated in the Chapter 4, the vast majority of reasons why many schools use Christian-published science textbooks center on themes of “biblical worldview instruction,” including “creationism,” “countering evolution,” and congruency with the “philosophy and mission of the school.” The codes in the category explaining why those same Christian schools do not use secular-published texts paralleled the positively-stated themes, merely stated again in the negative: “Secular texts do not provide a biblical worldview,” “do not present creationism,” and “do not discuss the flaws in evolutionary theory.”

The codes used by schools using secular-published science textbooks were more divergent, centering on themes concerning the depth or rigor of subject content. Several respondents mentioned the ancillaries available to the teacher from secular publishing companies, the opportunities to incorporate technologies into their teaching, and the quality of the graphics and illustrations. The themes for not using Christian-published

texts were the same, merely stated in the negative: “Christian-published texts lack content rigor,” “provide weak practice problems,” and the over-all “poor quality of the Christian-published texts.” The “exclusion of a presentation of other worldview interpretations” at the high school level was viewed by many teachers as a distinct weakness in Christian-published textbooks. Some respondents made assertive statements regarding the teacher being the “key source of worldview instruction” and as “modeling a correct Christian perspective on science.”

The link which connects the current experimental evidence that there is no difference in the ACT Science Reasoning scores of schools using a particular type of science textbook publisher to the strong preferences expressed for using a particular type of publisher can be found in the Christian philosophy of education discussed in Chapter 1 of this study. The major tenants of Christianity focus on creation, the fall of mankind as a result of disobedience, and redemption through faith in the sacrifice of Jesus Christ for sin (Fennema, 2001; Horton, 1992). These three are not listed in order of importance but in historical chronology. The most important of these is the redemption of the soul through faith in Jesus Christ (Gaebelein, 1954; Horton, 1992; Lowrie, 1978; Schultz, 2002). Every one of life’s greatest questions ultimately is addressed through one’s personal relationship to the Source of the answers.

The redemption of each student’s soul through personal faith in Jesus Christ is the essential purpose and mission of Christian education, and the triune nature of the student recognized by Christian educators gives focus to a biblical philosophy of education (Deckard & DeWitt, 2003). Academic subjects serve as the medium which leads faith to maturity and points to a clearer understanding and knowledge of God through biblical

worldview development. Every aspect of the curriculum points first to restoration, then to opportunities to grow that faith, and to bring the student to maturity through the training of the mind and body.

The selection of an appropriate textbook constitutes only one component in biblical worldview development (Acree, 2003; Cox, Hameloth, & Talbot, 2007; Moore, 2006). The choice of Christian-published or secular-published textbooks does not, in itself, bring about salvation and restoration. The curriculum provides a supportive role, scaffolding the process of worldview development and providing opportunities to interact with knowledge leading to growth and maturity in the student's relationship to God (Edelmann, 2006). The high schools which use Christian-published textbooks approach the academics (the training of the mind) through faith, whereas those which use secular texts approach faith through the academics. Is one approach better than the other in training the mind in the field of science? The sample statistics say 'no.' Whether worldview education is accomplished through the printed curriculum or through contrast with secular philosophy, the goal is the development of the mind in the context of the creation/fall/redemption themes of scripture. The choice of approach to worldview education should be clearly understood by the administration, faculty, staff, and constituency and reflect the written mission and goals of the individual Christian school.

The results of this study contribute not only to the depth of knowledge surrounding Christian education and the limited knowledge regarding science education in the Christian school but to the continuing professional interest on the part of educators in seeking effective curriculum materials for the Christian school.

Theoretical Implications

As discussed above and in Chapter 1, a biblical philosophy of education centers on the themes of the creation of all things by God, separation of mankind from God as a result of disobedience (the fall), and redemption through faith in Jesus Christ. It has been shown in Chapter 2 that the rise of conservative Christian schools in the late 1970s and early 1980s came, in part, as a response to public education which was seen as deviating from traditional values, biblical authority, and parental control in the education of children. The Christian school, along with the local church, became an extension of the home, assisting Christian families in the education of their children.

Not only does the understanding of the origins and history of Christian education influence the curriculum and choice of curriculum materials, it also frames learning theory. As discussed in Chapter 2, learning theory has evolved over the last century in its interpretation of what students should know, how students learn, and how learning is organized. Just as a pendulum circumscribes an arc in its path, so the theories of Behaviorism, Cognitivism, and Constructivism have moved from reality as defined by the society to reality as defined by the individual; from teacher-centered instruction to student-centered learning; from learning as a product of education to learning as a process independent from the educational setting; and from absolutes to relativism (Carbonell, 2004; George Mason University, 2006; Graham, 2007; Terwell, 1999; University of Washington, 2003; Virginia Community College, 1998).

In Christian education the pendulum of learning theory is anchored in the absolute position which best reflects the principles of scripture: Society's perception of reality is a distortion of what God intended; wisdom comes with age; the teacher is a guide, example, and source of content knowledge; and learning is the vehicle through which one

understands God, creation, and human nature. The difference between Christian and secular learning theories is the expected product of education. Secular theory assumes the only outcome of interest is academic achievement, whereas Christian education focuses on the outcome of a student's mature relationship with Jesus Christ through the process of learning. The characteristics of an effective Christian school go beyond the curriculum to include the development of the Christian mind and the recognition of gifts and talents. Burkett (2008) aptly states, "While academic excellence is important, spiritual transformation is what distinguishes the mission of a Christian school from that of its secular counterparts" (p. 18).

The most effective classroom practices are efficient and gleaned from a variety of sources identifying best practices. Each learning theory possesses strengths and weaknesses, and the Christian school teacher discerns between the two. The Christian teacher is not confined by the theory of the day but searches for what works best for the students. Identification of teacher expertise in the setting of the Christian school takes into account the nature of students with their unique set of mental, physical, and spiritual needs, and the teacher's influence on these students through the subject content, the methods of communication, and personal conduct (Guthrie, 2008; Schultz, 2002). The best and most effective practices belong to the Christian educators who desire to be masters at their craft with a passion for their subject.

No curriculum is teacher-proof nor is it desirable to have one which is. A constant system of checks and balances between the curriculum, the skills and abilities of the teacher, and the mandates of scripture regarding the education of children allows the Christian school to fulfill its mission and purpose. Christian schools "should be good

schools. Good schools are rigorous schools, and rigorous academic programs beget results. In the challenging economy that parents are facing, one of the significant reasons for them to stay enrolled in our schools is results” (Keenan, 2008, p. 43).

Explanation of Unexpected Results

Two unexpected results became apparent early in the execution of this study. First, the rate of return from the original mailing was expected to be 50%. In actuality it was 40%. One explanation might reflect the fact that Christian school teachers and administrators have multiple responsibilities and their time is highly scheduled. Tasks are often prioritized, with the least urgent often set aside. This was, in fact, the comment from some late-arriving surveys. In addition, the questionnaires were received by the schools in mid-January, when some schools may have scheduled mid-term examinations. The time pressures of preparing, administering, and grading examination, coupled with end-of-semester grades, may have caused the questionnaire to receive low priority. A comment from one respondent who was contacted for follow-up stated that when she realized she had missed the original deadline, she assumed submitting the questionnaire late would be of no value. Several other respondents indicated they had not received the first mailing.

The second unexpected result was the low percentage of respondents requesting a summary of the research results. The questionnaires provided an opportunity for the participants to indicate an interest in receiving a summary of the findings during the summer of 2009, upon completion of the research. Only 48 of the 128 respondents requested a summary of the results. At first, there was a concern that the participants’ perception of the value of this research was low, and they were not particularly interested

in knowing whether their science curriculum was effective in preparing their students for college. However, of those 48 schools requesting a summary, 10 requests were from school that had been eliminated from inclusion in the study for various reasons but still were interested in the results of this research, regardless of whether the results affected them directly.

Implications for Christian Educators

The current research provides, to some degree, a preliminary validation study of the effectiveness of Christian-published science textbooks in preparing students for the college science experience. As conservative Christian schools grow in number, decisions regarding the selection of curricular materials at the high school level should be based on a clear understanding of their effectiveness. Two overarching implications are evident as a result of this research. One addresses an application of the findings within the Christian education community, while the second provides insight as to outsiders' views of the effectiveness of a Christian education.

Firstly, fidelity to the biblical philosophy of education involves training the souls, the minds, and the hearts of young people. The scriptural references to instruction always occur within the context of interpersonal relationships, conversations and discourse, and actions which model correct living. Perhaps even more than in the public school setting, the Christian school teacher's influence on the development of a child arises from the teacher's personal relationship with and knowledge of Jesus Christ. The teacher's responsibility in biblical worldview instruction is not relinquished to the type of textbook publisher. The issue is not faith *or* academics but faith *with* academics. Comfort is not found in Christian-published texts themselves but in their use as tools to reinforce what is

done and said by the teacher in and outside the classroom. The adequacy of a Christian textbook as a source of worldview instruction does not guarantee biblical worldview development in the students. Likewise, Christian school teachers using secular-published textbooks need to be vigilant in seeking opportunities to exegete scripture. Any curriculum in the hands of a competent Christian teacher makes the curriculum Christian.

Secondly, the results of this and similar studies could have a significant influence in the secular community and its perception of Christian education. Many of the criticisms of a Christian education mentioned in Chapter 1 of this research either address the quality of the curriculum, uncertified faculty, or the general inferiority of a Christian school education. These criticisms could be assuaged by continued research in Christian education. The results of this study seem to indicate

1. the quality of the academic curriculum is sufficient to produce ACT Science Reasoning scores which are above the national average, and
2. the percentage of uncertified teachers is the same, if not a little less, than that found in public schools.

The secular education community recommends that policies and practices be based on and driven by sound research. As the results of sound research regarding the policies and practices of conservative Christian schools are assembled, many criticisms of Christian schools can be refuted. For example, a prominent lawsuit was filed in 2006 by students from Calvary Chapel Christian School, California, against the University of California in Los Angeles (UCLA). UCLA refused to accept credits from “religious-themed classes” (“High School Students Sue UC”, 2006), contending they lack relevant academic content (Cockrell, 2005; Kasindorf, 2006; Dean, 2005). Rejected courses,

including history, English, social studies, and science, used textbooks published by A Beka and BJUP. The students replied with accusations of “viewpoint discrimination” and the Association of Christian Schools International voiced concerns over protecting religious rights (Association of Christian Schools International, 2005). The decision of the university was upheld by Federal court on August 13, 2008, and is on appeal to the Ninth U.S. Circuit Court of Appeals. An examination of the students’ ACT test results may provide evidence supporting the school’s curriculum. The effectiveness of a Christian school education can be found in the quality of the product.

A second example addresses the ACT and SAT college entrance examinations designed to measure a student’s readiness for college. If these secular organizations define the characteristics of a college-ready high school graduate, then the quality of the high school education should be based on that measure, regardless of the curriculum used. Producing quality students with a quality education presents a challenge to all Christian schools toward excellence. According to this study, Christian school students are as well-prepared, if not better-prepared, than those of the public schools in the skills necessary for college success.

A third example of the application of the finding of this current research addresses the pressure exerted by some states to force Christian schools to adhere to state curriculum mandates and standards (Robelen, 2008). The observation that the average standardized test scores of Christian school students rank above the national average attests to the fact that Christian schools are accomplishing their goal of producing literate citizens without the need for such mandates and curriculum guidelines. The decision regarding the quality of academic preparation given to Christian school students can be

made by the secular community's own criteria – standardized achievement tests and Advanced Placement scores. The evidence for excellence in a Christian school can be seen in the quality of spirit, mind, and body of its students.

Limitations of this Study

Several assumptions exist regarding the data and their interpretation which limit the generalizability of the results.

1. For purposes of this study, all schools were considered equal in the statistical analysis regardless of the size of each school, the number of students in the graduating class of 2008, or location of the school. Only a single ACT Science Reasoning score was considered from each school. Therefore, the average ACT score for each type of publisher may be somewhat skewed.
2. Inherent weaknesses in causal/comparative research are the inability to a) manipulate the independent variable; b) control many of the extraneous variables; and c) randomly select the subject schools.
3. The results and, therefore, their generalizability are influenced by numerous extraneous variables including
 - teacher qualifications, experience, and expertise,
 - science facilities and equipment,
 - average number of laboratory experiences per month,
 - students who enter or exit the science course sequence during their high school experience,
 - schools which use a combination of Christian and secular texts in the required science courses, and

- schools which changed to or from Christian-published texts in the last four years.
4. The sample of Christian schools was limited to the five Midwest states of Illinois, Indiana, Michigan, Ohio, and Wisconsin.
 5. Selection of the subject schools was based on the United States Government definition of conservative Christian schools: schools which hold membership in the American Association of Christian Schools, Association of Christian Schools International, and Oral Roberts University Educational Fellowship. Accelerated Christian Education (ACE) schools, although included in the government's definition of conservative Christian schools were omitted from this study as a result of their unique approach to education in which traditional textbooks are not used.
 6. Any schools which may be conservative in philosophy and practice but do not hold membership in one of the named organizations were omitted although they could make a contribution to the data regarding ACT scores and Christian-published textbooks.
 7. It was assumed that the ACT Science Reasoning scores of the participant schools are valid indicators of college readiness and, in turn, reflect accurately the academic preparation provided by the textbook publisher used in the high school science curriculum.
 8. The uncontrolled extraneous variables pertaining to the quality of the science equipment and facilities, the experience, certification and expertise of the science faculty, and the school size have an effect on the success of the curriculum. No

curriculum is uninfluenced by the context in which it is taught.

Recommendations for Further Study

The United States Government defines strong evidence of effective practices as those involving randomized controlled trials that are well-defined and executed in multiple school settings (United States Department of Education, 2003). The body of research-based knowledge surrounding best practices in Christian education is limited and somewhat contradictory, often reflecting the researchers' biases. The following recommendations have been made to increase knowledge of best practices in Christian schools and address many of the extraneous variables within this study.

1. In the area of science education in Christian schools, research is less than scant and warrants further investigation.
2. For the purposes of this study, all schools were treated equally for statistical purposes. The parameters of the population should be refined in search of further trends in science education, including correlations involving the age and size of the school, socioeconomic variables, and rural versus urban settings.
3. For the purposes of this study, all ACT scores were treated equally for statistical purposes. The ACT Science Reasoning scores should be weighted by the number of graduates in the class before calculating the means to investigate the possibility of different results.
4. The scores on the ACT Science Reasoning subtest should be correlated with the Mathematics subtest within the context of Christian schools.
5. *Post hoc* examination of the questionnaire responses should be conducted to determine any relationship between the ACT Science Reasoning scores and the

number and kinds of science courses required for graduation and the years of teacher experience.

6. Additional *post hoc* examination should be conducted to determine any relationship between the ACT Science Reasoning scores and Advanced Placement science courses offered by the schools.
7. Using ACT subtest scores in English and Reading, the effectiveness of Christian-published textbooks should be investigated in other areas of the formal curriculum.
8. Topic by topic, the strengths and weaknesses of the science textbooks published by the most prominent Christian publishers should be investigated.
9. Topic by topic, the strengths and weaknesses of the science textbooks published by Christian publishers should be compared to their secular counterparts.
10. This research should be continued with a longitudinal study following Christian school graduates representing the two types of science curriculum approaches through their first-year college science experiences in both Christian and secular universities.
11. The influence of the high school science experience on decisions to pursue science-related careers should be investigated.
12. The effectiveness of biblical worldview training in schools using Christian-published curricula should be compared to those schools using secular-published curricula.
13. Through intensive qualitative research, a biblical model of teacher expertise should be established for science education in the Christian school.

This study represented an investigation of the effectiveness of Christian-published science curriculum materials in the preparation of Christian school students for the rigors of introductory college science courses. It has provided the Christian education community with a broad sketch of the state of science education in the 21st Century. It has, however, illuminated only one brushstroke in that sketch: the effectiveness of the type of science textbook publisher. While the confidence in the statistical results was set at 95%, no single research study can, nor should be, embraced as definitive or global in its impact. Only through multiple studies, in multiple settings, using multiple methodologies can the body of knowledge surrounding effective Christian schooling be enriched.

Christian educators recognize that their calling is an eternal endeavor, transcending subject content. The decisions and policies made within the Christian school become informed through solid research and theory and, ultimately, through a wisdom which comes from an intimate relationship with the source of all wisdom and knowledge, God Himself.

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APPENDIX A

Science Curriculum Research Questionnaire

The purpose of this research is to determine the relationship between the publisher of the curricular materials used in 9-12 science courses and ACT Science Reasoning scores.

1. Does your school serve students in grades 9 – 12? (circle) Yes No
2. Is the ACT college placement test taken by your students? Yes No
3. Are textbooks used in your required science courses? Yes No

If your answer to any of these three questions is “no,” please return the questionnaire in the envelope provided. Thank you for your participation. If the answers are “yes,” please continue.

4. How many years has your school been in existence? _____
5. Number of students enrolled in grades 9 – 12 _____
6. Number of students in the graduating Class of 2008 _____
7. Number of years of science required for graduation 1 2 3 4
8. Science courses required for graduation biology chemistry physics other _____
9. Total number of science teachers full- time _____ part-time _____
10. Number of laboratory experiences per month
- | | | | | |
|-----------|-----|-----|-----|----|
| Biology | 0-1 | 2-3 | 4-5 | 6+ |
| Chemistry | 0-1 | 2-3 | 4-5 | 6+ |
| Physics | 0-1 | 2-3 | 4-5 | 6+ |
11. Average number of years of experience of the science teachers _____
12. How many of the science teachers are state certified? _____, AACS certified? _____, ACSI certified? _____, ORUEF certified? _____, licensed? _____, other(s) _____, not certified or licensed? _____
13. Science courses offered in grades 9 – 12 (Please check all that apply):
- | | | |
|--------------------|------------------------------|------------------|
| ___ Biology | ___ Anatomy | ___ AP Biology |
| ___ Chemistry | ___ Organic Chemistry | ___ AP Chemistry |
| ___ Physics | ___ Conceptual Physics | ___ AP Physics |
| ___ Marine Biology | ___ AP Environmental Studies | ___ ChemCom |
| ___ Earth Science | ___ Astronomy | Other(s) _____ |
14. As compared with other Christian schools, how would you rate your school’s science facilities?
- | | | | |
|------|---------------|---------------|-----------|
| Poor | Below average | Above Average | Excellent |
|------|---------------|---------------|-----------|
15. Your school’s **ACT Science Reasoning** score for the Class of 2008 _____
(This score ranges from 1.0-36.0 and is available through your administrator or guidance counselor.)

16. Excluding Advanced Placement, does your 9–12 required science curriculum utilize

A. Christian-published science textbooks **exclusively**? If so, please check all publishers used.

- | | | |
|--|--|---|
| <input type="checkbox"/> A Beka Books | <input type="checkbox"/> Alpha Omega | <input type="checkbox"/> Bob Jones University Press |
| <input type="checkbox"/> Christian Liberty Press | <input type="checkbox"/> Christian Light | <input type="checkbox"/> Cumberland |
| <input type="checkbox"/> Concordia Press | <input type="checkbox"/> Cornerstone | <input type="checkbox"/> Pathway Publishers |
| <input type="checkbox"/> Accelerated Christian Education | | <input type="checkbox"/> Seventh Day Adventist |

Other(s) _____

B. secular-published science textbooks **exclusively**? If so, please check all publishers used.

- | | | |
|--|---|---|
| <input type="checkbox"/> Allyn/Bacon | <input type="checkbox"/> Barron's | <input type="checkbox"/> Brooks/Cole |
| <input type="checkbox"/> Glencoe | <input type="checkbox"/> Harcourt/Brace | <input type="checkbox"/> Holt/Rinehart/Winston |
| <input type="checkbox"/> Houghton/Mifflin | <input type="checkbox"/> Kendall/Hunt | <input type="checkbox"/> Macmillan |
| <input type="checkbox"/> McDougal/Littell | <input type="checkbox"/> McGraw/Hill | <input type="checkbox"/> Pearson |
| <input type="checkbox"/> Prentice-Hall | <input type="checkbox"/> Sargent-Welch | <input type="checkbox"/> Scott Foresman/Addison
Wesley |
| <input type="checkbox"/> Silver Burdett/Ginn | <input type="checkbox"/> Thomson Learning | <input type="checkbox"/> John Wiley |

Other(s) _____

C. a combination of Christian and secular science textbooks? If so, please indicate the publisher(s) used.

- | | |
|-------------------------|-----------------|
| Biology | publisher _____ |
| Chemistry | publisher _____ |
| Physics | publisher _____ |
| Other required sciences | publisher _____ |

17. Has there been a change to or from Christian-published science textbooks within the last four (4) years? Yes No

18. In your opinion, what would you cite as the *major* reason your school chooses to use the type of science textbook publisher it does, whether Christian or secular?

Thank you for your participation. Please return the questionnaire in the envelope provided by January 23. If you are interested in receiving a summary of the results of this study, mark the circle on the front of the return envelope.

APPENDIX B

Cover Letter and Questionnaire Field Test Results

A field test of the Cover Letter and Questionnaire was conducted on November 11, 2008 involving three administrators, the dissertation editor, the statistician, and one teacher. After reviewing the intent of the study, each was asked to read the cover letter for content, understanding, ambiguity, and flow of ideas. Their advice resulted in the following changes to the cover letter:

1. In the first line, add the identified that I am the chemistry teacher as well as the department chair at my school.
2. Include only one email address in the signature section and eliminate the school's address since it will appear on the letterhead.
3. Reword the first sentence of the second paragraph to clarify how the individual schools were selected.

Suggestions for corrections on the questionnaire included:

1. Clarify the contingency statement appearing after question 3 allowing the respondent to end the survey at that point and return it in the envelope provided.
2. Regarding question 10, distinguish between full-time and part-time science teachers by allowing the respondent to merely enter a number on the line provided.
3. Regarding question 11, reword the question to include types of certification held by the science teachers.

4. Provide direction in question 16 for the respondent in finding the ACT Science Reasoning score if unknown by adding the statement “This score ranges from 1.0 to 36.0 and is available through your administrator or guidance counselor.”

A second field test of the cover letter and questionnaire was conducted on November 20, 2008 involving three high school science teachers. They were requested to address understanding, ambiguity, flow of questions, ease of completion, and time required for completion. Suggestions included:

1. Change the number of laboratory experiences in question 10 from “per week” to “per month.” This would enable the respondent to more precisely estimate the number of labs completed within that time frame.
2. Reverse the order rating the science facilities in question 15 to begin with “poor” and end with “excellent.” The question arose as to why an “average” rating was not included. It was agreed that that absence of the “average” rating would force the respondents to make a more critical judgment of their facilities.
3. Italicize the word “major” in question 19 to encourage reflection on the part of the respondent.

The suggestions offered as a result of the field studies were considered and deemed appropriate. Corrections were made accordingly.

APPENDIX C

Cover Letter

January 8, 2009

Dear Fellow Science Educator,

My name is Janice Guthrie, and I am the science department chair and chemistry teacher at Southfield Christian School in Southfield, Michigan. I am completing my Educational Doctorate at Liberty University in Virginia during this school year. For my dissertation, I have selected an investigation of the 2008 ACT Science Reasoning scores of Midwest Christian high schools which use Christian-published science textbooks as opposed to secular-published texts. I believe this study will provide valuable information for the Christian school community and give direction to individual Christian schools in the selection of curricular materials for the purpose of preparing our students for college-level science courses.

You have been selected to participate in this study because of your school's affiliation with one of the conservative Christian school associations: American Association of Christian Schools, Association of Christian Schools International, or Oral Roberts University Educational Fellowship. Your school's name and address were obtained from the association's website. To achieve accurate representation from Midwest Christian schools, I encourage your completion of this questionnaire. Responding should take approximately ten minutes of your time, but your information and participation are crucial to the results of this study. After completion, please return the questionnaire in the enclosed self-addressed stamped envelope by **January 23**.

You may be assured that your responses will remain completely anonymous. The name of your school, your state, or any other identifying information, does not appear on the questionnaire nor will they appear in this research study. The return envelope has been marked with an identification number that will allow us to check your name off the mailing list when the questionnaire is returned. If you are interested in receiving a summary of the results, please check the circle on the front of envelope and it will be mailed to you by mid-summer, 2009. The envelope will then be discarded. The information gathered will be aggregated and used for statistical purposes only.

I thank you for your willingness to provide the data on the enclosed questionnaire. If you have any questions about the study, please feel free to email or call.

Your participation is greatly appreciated.

Sincerely,

Janice Guthrie

Science Department Chair, Southfield Christian School
jguthrie@southfieldchristian.org
(Home) 248 357 4026 (School) 248 357 3660 x 418

APPENDIX D

IRB Research Proposal Form

9/07 **RESEARCH EXEMPTION REQUEST** Ref. # _____**Liberty University****Committee On The Use of Human Research Subjects**

1. _____

Project Title: The Effect of the Use of Christian-Published Science Textbooks on the ACT Science Reasoning Scores of Midwest Christian High Schools

2.

Please list all sources of funding. If no outside funding is used, state "unfunded":
 unfunded

3a. Principal Investigator(s) *[Must be a Liberty faculty member or investigator authorized by the Chair of the Institutional Review Board. If a student is the principal investigator, the student must have a faculty sponsor. Include contact information for both the student and the faculty sponsor as appropriate]:*

Student	Janice Marie Guthrie, Graduate
Name and Title	(248) 357-4026
	jmguthrie@liberty.edu
	20365 South Greenway Street
	Southfield, Michigan 48076
	Phone, E-mail, correspondence address

3b. Faculty Sponsor

Dr. Michelle B. Goodwin	Department of Teacher Education
Name and Title	(434) 582-2265

mbgoodwin@liberty.edu

Dept., Phone,

E-mail address

Anticipated Duration of Study: January, 2009 June, 2009
 From To

4. Briefly describe the purpose of the study.

The purpose of this study is to determine if there is a difference in the ACT Science Reasoning scores of Christian high schools using Christian-published science textbooks as compared to those schools using secular-published textbooks.

5. Provide a lay language description of the procedures of the study. Address ethical issues involved in the study (See the Avoiding Pitfalls in section of the IRB website for helpful suggestions) and how you will handle them. For example, consider issues such as how subject consent will be obtained (or explain why the study meets waiver guidelines for informed consent), how the data will be acquired, and how the data will be stored confidentially once it is collected. Please attach pertinent supporting documents: all questionnaires, survey instruments, interview questions and/or data collection instruments, consent forms, and any research proposal submitted for funding.

The type of study is quantitative involving causal, correlation, and survey design. A questionnaire (attached) will be mailed to approximately 250 conservative Christian high schools in the Midwest states of IL, IN, OH, MI, and WI. The names and addresses of the subject schools will be obtained from the websites of the Association of Christian Schools International, the American Association of Christian Schools, and Oral Robert University Education Fellowship. The questionnaire will be accompanied by a cover letter of introduction (attached) and will be addressed to the science department chairperson. The cover letter assures confidentiality and anonymity and offers a summary of the findings to those who request it. The self-addressed stamped envelope provided for the return of the questionnaire will be numbered for the sole purpose of tracking those questionnaires returned and not returned. After the information has been recorded, the envelopes will be discarded. Neither the name of the school or any identifying information will appear on the questionnaire itself or in the final written research paper.

The questionnaire requests the following information:

- The school's ACT Science Reasoning score
- Whether the school uses Christian-published or secular-published science textbooks
- Specifically which publishing companies are used (selected from a check-list)
- information on several extraneous variable such as
 - Age of school
 - Enrollment in grades 9-12
 - Number of students in Class of 2008
 - Number of years of science required for graduation and title
 - Science courses offered
 - Number of science teachers
 - Number of laboratory activities per week

Average number of years of experience of the science teachers
 Types of teacher certification held
 Rating of science facilities
 -one open-ended question requesting the major reason for the school
 choosing that particular type of textbook publisher (Christian / secular)
 The data will be maintained on an Excel spreadsheet on which individual
 schools will
 be identified as a numbers only.

The information gathered will be aggregated for statistical purposes only. This research methodology meets the guidelines of the Research Exemption Request, Category 2b: The survey involves no more than minimal risk to the participants, no special populations, no recording devices, and it will collect non-sensitive data anonymously. A research exemption is requested.

6. Will subject's data be gathered anonymously? YES NO

7. Please describe the subjects you intend to recruit. For example, minors under age 18, adults 18 and over, students, etc. Also, please describe your recruitment procedures. How will you find participants for your study? How will you contact them? Please be explicit.

The subjects consist of conservative Christian high schools belonging to The American Association of Christian Schools, the Association of Christian Schools International, and the Oral Roberts University Education Fellowship in the five states mentioned above. Access to the names and addresses of the schools were found on the website of each organization. The questionnaire will be mailed to the "Science Department Chair." School data only will be requested; No data on individual students will be requested.

I have read the Human Subjects "Research Exemption Request Guidelines".

Janice Marie Guthrie

December 19, 2008

Principal Investigator Signature(s)

Date

 Faculty Sponsor (If applicable)

 Date

APPENDIX E

Liberty University Institutional Review Board Approval Letter

December 22, 2008

Dear Janice,

We are pleased to inform you that your above study has been approved by the Liberty IRB. This approval is extended to you for one year. If data collection proceeds past one year, or if you make changes in the methodology as it pertains to human subjects, you must submit an appropriate update form to the IRB. Attached you'll find the forms for those cases.

Thank you for your cooperation with the IRB and we wish you well with your research project. We will be glad to send you a written memo from the Liberty IRB, as needed, upon request.

Sincerely,

Fernando Garzon, Psy.D.
IRB Chair, Liberty University
Center for Counseling and Family Studies Liberty University
1971 University Boulevard
Lynchburg, VA 24502-2269
(434) 592-4054
Fax: (434) 522-0477

APPENDIX F

Sample Codes and Categories

The following comments represent many of the codes used by respondents when answering item 18 of the questionnaire: *In your opinion, what would you cite as the major reason your school chooses to use the type of science textbook publisher it does, whether Christian or secular?* (The actual wording has not been altered.)

- I. Codes from schools using Christian-Published Texts
 - A. PRO -Christian-Published Textbooks
 1. Christian emphasis; supports biblical foundation/training
 2. Good content; solid information
 3. Clear and accurate presentation of the material
 4. Gospel presented correctly
 5. Does not promote secular theory
 6. Follows school's philosophy, mission
 7. Best to achieve understanding
 8. Glorifies God
 9. Teaches, reinforces biblical worldview; Christian perspective/philosophy
 10. Challenging
 11. Alternative activities
 12. Emphasis on reasoning skills
 13. Teacher helps; ease of use
 14. Creation-based

15. Students end up knowing biblical concepts
16. Shows science and Christianity do not have to be contradictory
17. De-emphasis on evolution; correct position on evolution
18. Solid development of scientific thought process (critical thinking)
19. Students well-grounded in biblical creation theory; creationist worldview
20. High quality
21. Low cost
22. School board will not consider secular texts
23. Good text sequence
24. Eliminate false doctrine
25. Used throughout the school

B. AGAINST Secular-Published Textbooks

1. Takes teacher time to refute untruths
2. Content confuses students
3. Evolution interwoven throughout all subjects; becomes necessary to defeat the constant evolution propaganda

II. Codes from schools using Secular-Published Texts

A. PRO Secular Texts

1. Prepare students to read science critically
2. More comprehensive content
3. Accurate, up-to-date
4. Better illustrations, figures, graphics
5. Engaging, readable, do-able labs

6. Best text available for the subject
7. Prepares students for secular universities
8. Curriculum sequence
9. Teacher support materials; ancillaries
10. Strong foundation in the sciences
11. Based on state curriculum and standards; align with state standards
12. Necessary to lead to AP courses
13. Contain better science
14. Better quality
15. Cutting-edge technology
16. Better fit for our students

B. AGAINST Christian Texts

1. Paperback; poor quality; quality of material
2. Inadequate coverage of scientific content
3. Inferior in depth and pedagogy
4. Not adequate/unsuitable for upper-level classes; not available for some subjects
5. Exclude other worldviews/interpretations
6. Some too sectarian
7. Weak in practice problems
8. Christian perspective can come from teacher
9. Lack academic rigor for college-bound students