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The Educational Emphases of Science Teachers in US Evangelical Protestant High Schools

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Abstract

I examine the educational emphases of science teachers in Evangelical Protestant (EP) schools, including (1) teaching basic content knowledge, (2) improving scientific reasoning skills, and (3) presenting real-world applications of science. Using a nationally representative sample of US ninth-graders, I find differences in these educational emphases between science teachers in EP schools and science teachers in secular private, Catholic, and public schools. I also find suggestive evidence that differences in STEM-related student outcomes across school sectors, which have been demonstrated in prior research, are associated with cross-sector differences in the emphases of science teachers.

Keywords: STEM education, teaching practice, Catholic schools, Evangelical Protestant schools, science pedagogy

The Educational Emphases of Science Teachers in US Evangelical Protestant High Schools

Scholars of Christian education have recently issued appeals for Evangelical Protestant (EP) schools to reflect upon their teaching practices and to develop distinctly Christian practices that better serve their communities (Green, 2016; Smith et al., 2014; Smith & Smith, 2011). Responding to this appeal requires familiarity with the nature of teaching practices that currently occur in the EP schools and the ways they might shape student outcomes. However, there is presently little systematic understanding of these practices. The aim of this study is to begin to address this gap by taking stock of the educational emphases of science teachers in EP schools and how these emphases might influence their students, especially with respect to outcomes relevant to the science, mathematics, engineering, and technology (STEM) fields.

I consider the experiences of EP-school students in their sciences classes given the salient link between science and Christian faith. The tensions between faith and science that these students experience and long-standing controversies surrounding the teaching of religion and science are well documented in the research literature (Billingsley et al., 2016; 2014; Hill, 2014). Likewise, graduates of EP schools follow distinct life trajectories in terms of educational attainment and employment in the STEM fields. These graduates are, for example, less likely to pursue STEM degrees or jobs in certain STEM fields, perhaps suggesting a unique influence of EP schools on their students' perceptions and attitudes towards sciences (Sikkink 2014; Pennings et al., 2014). However, links between these outcomes and teaching and learning practices in EP science classrooms have not been made to date.

In this study, I use a nationally-representative sample of U.S. ninth-grade students to describe and compare the educational emphases of science teachers in EP schools with those of science teachers in Catholic, secular private, and public schools. Relying upon the longitudinal nature of the data, I also examine the extent to which differences in educational emphases across these school sectors drive differences in the STEM-related student outcomes that have been documented in prior research.

I find that relative to science teachers in other school sectors, science teachers in EP schools place different amounts of emphasis on improving scientific reasoning skills and presenting the real-world applications of science. I do not find differences in the extent to which EP teachers emphasize instruction in basic content knowledge. Additional analyses suggests that educational emphases are associated with STEM-related student outcomes. In particular, students are less likely to pursue a degree in a STEM field in college if their science teacher spends less time emphasizing the ways science can be applied to daily life and employment. Moreover, cross-sector differences in educational emphases are correlated with cross-sector differences in longer-run, STEM-related outcomes. This last result suggests that the unique life trajectories of EP school graduates with respect to STEM may be a function of the educational emphases of their science teachers. It is important to explicitly state that these findings are correlational, not causal, as I cannot rule out the possibility of unobserved factors that explain, for example, both entry into a particular science classrooms and student outcomes.

The remainder of the article is divided into four sections. In the next section, I describe the existing research on EP views of science, the nature of teaching and learning practices in EP science classrooms, and the STEM-related outcomes for students who attend EP schools. Next, I describe the data set that I use to explore cross-sector differences in teaching and learning practices and their associations with student outcomes. I then present results and conclude with a discussion of these results, suggesting implications for the subsequent study and development of Christian teaching practice.

Literature Review

Views of Science and Religion among Protestants

Christian beliefs about the origins of life and Darwin's theory of evolution often underpin conflicts between religion and science. These tensions are particularly salient in the United States where the Scopes Trial and related controversies surrounding science curriculum mark the history of its educational institutions (Berkman & Plutzer, 2010; Dávila, 2014; Noll, 2002). Religious conservativism and fundamentalism unique to some Christian subpopulations in the United States also contribute to the general skepticism of scientific claims such as evolution and climate change (Coyne, 2012; Evans, 2011; Evans & Feng, 2013; Miller et al., 2006). Notably, this sense of skepticism and conflict has been increasing since the 1970s, particularly among the most conservative Protestants (Evans, 2013; Gauchat, 2012).

Christian school-aged children are not always adept at negotiating the tension between the scientific and religious frameworks of understanding the world. They often perceive a conflict between science and religion or view the two fields as mutually exclusive (Billingsley 2013; Billingsley et al., 2016; Brickhouse et al., 2000; Hill, 2014). Students also vary in the extent to which they have critically engaged with and reflected upon tensions between religion and science (Hanley et al., 2014).

The common perception that science and religion are in conflict may partially be due to unique teaching and learning practices in these two content areas. Science and religion teachers typically do not collaborate with each other about their curricula, and instruction in science courses tends to be siloed with respect to religion courses and vice versa (Billingsley et al. 2014). The extent to which students interact with issues concerning the relationship between science and religion often depends on the initiative of individual teachers. While some teachers explicitly avoid discussion of controversies between religion and science, others are more willing to raise these issues and view them as important for their students' intellectual growth (Griffith & Brem, 2004). Science teachers also vary widely in the amount of instructional time that they dedicate to evolution and creationism and are quite diverse in their own personal positions regarding these topics (Berkman et al., 2008; Moore & Kraemer, 2005; Rutledge & Mitchell, 2002).

Nonetheless, some students maintain that science and religion can be integrated or that propositions from one field can advance the understanding of the other (Barbour, 1990). Research of school-aged children demonstrates that they often attempt to synthesize inconsistent views or are able to tolerate some levels cognitive dissonance (Longest & Smith, 2011; Taber et al., 2011; Winslow et al., 2011; Yasri & Mancy, 2014). Students who hold a more positive attitude towards religion do not necessarily hold more negative attitudes towards science. In fact, the opposite may be true. They tend to hold more positive attitudes towards science, but they typically hold negative attitudes towards scientism (Astley & Francis, 2010). Similarly, research suggests that conservative Protestants in the U.S. generally accept the scientific method and the results from scientific research. Opposition to science is more specifically limited to disagreement over a limited set of factual claims, moral interpretations, and policy implications that scientists often make based upon their research (Evans, 2011; 2013; Evans & Feng, 2013; Schwartz & Sikkink, 2016).

Though research has provided some insight into how students and teachers negotiate the relationship between science and religion, less is known about how schools do so at an organizational or institutional level. This issue is particularly salient for EP schools which are confessional in nature and yet are tasked with teaching science courses. It is plausible that the unique position of EP schools will give rise to distinctive approaches to teaching and learning in science. These practices, in turn, may influence students in certain ways. I test these propositions in this study.

Teaching and Learning Practices in Science Classrooms of Evangelical Protestant Schools

To begin understanding how EP schools negotiate the relationship between science and religion, some description of the historical context about EP schools would be worthwhile. Many EP schools that exist today were established in the 1960s and 1970s in response to what many Protestants perceived to be an increase in secularization and a rise in the prominence of scientism. Social trends epitomized by key Supreme Court decisions, such as those banning prayer in schools or declaring abortion to be a legal right, motivated Protestant communities to start their own schools to provide an education that was more consistent and infused with their religious beliefs (Carper, 1983). If many EP schools arose as a countervailing response to secularism and scientism, it is possible that they also formed distinctive practices regarding the teaching and learning of science. That is to say, the tension between religion and science that many evangelical Protestants experience may be embodied in certain ways at an institutional level within EP schools. Indeed, philosophers of Christian education have articulated distinctive conceptions of science education — a hallmark of which is the primacy of general and special revelation by God as a means to understand the natural world. Scientific conclusions must be interpreted in light of such revelation (Knight, 2006; Van Brummelen, 2002).

In contrast, these tensions may be less salient in Catholic schools which were formed much earlier in the 19th century and for reasons other than a response to increasing secularization[1]. Since the early 20th century, Catholic leaders have affirmed the usefulness of

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[1] It is important to note that not all Protestant private schools were established in response to political and social dynamics of the 1960s and 1970s. Observations made about Catholic schools can also be made for some Lutheran schools that were formed around the same time as Catholic schools (Isch, 2002).

science and, without the tradition of biblical literalism common to some EP communities, more readily embrace scientific discoveries and integrate them into their theology (Harris, 2002). Since the middle of the 20th century, Catholic schools, which were predominantly located in urban centers, also drew upon their social justice traditions and placed greater emphasis on serving families from low socioeconomic backgrounds. Motivated to improve the life prospects for children in these families, Catholic schools focused on preparing these students for postsecondary education and employment. Such efforts required holding high expectations for academic achievement, including in the STEM fields. Catholic schools needed to be open towards and to embrace science education to fulfill this mission (Bryk et al., 1993; Cheng et al., 2016; Sikkink, 2014; Trivitt & Wolf, 2011; Van Pelt et al., 2011).

Despite these reasons to expect distinctive teaching practices in science classrooms of EP schools, relatively little is known about them at scale and how they differ from practices in public, Catholic, and secular private schools. In a study of instructional practices in science classrooms in the U.S., Burton (1998) found few differences between EP schools and non-EP schools. Whether such patterns still persist today is an empirical question. It is also possible that differences may have been obscured by the measures that Burton used; asking teachers to report how often they used “cooperative learning” or “lecture” may not have yielded measures that were precise enough to provide fine-grained descriptions of instructional practices. Notably, Sikkink (2001) notes that many EP schools regularly utilize professional practices that public schools also utilize, again suggesting more similarities than differences across the two school sectors. Another inquiry into the teaching practices of science classrooms in Seventh-Day Adventist schools revealed that teachers often utilized class discussions and student projects in their instruction. However, no comparison group was available to make additional claims (Burton et al., 2004).

Teaching and Learning Practices and Student Outcomes

Given the dearth of empirical work comparing teaching and learning practices in EP and other schools, it should not be surprising that studies have not linked specific practices to student outcomes. One exception is a study of science textbook usage in EP schools. Some EP schools rely upon secular science textbooks, whereas others rely on versions produced by Christian authors and publishing companies. EP educational communities have debated the kinds of science textbooks that should be used. Proponents of textbooks produced by Christian publishing companies argue that they are more effective for teaching and instilling faithfulness to a Christian worldview (Cox et al., 2007). However, research on textbook usage finds little relationship between the type of textbook, the frequency of its usage, and measures of student religiosity or Christian-worldview formation (Reichard, 2016). This work suggests that other aspects of teaching and learning besides textbook selection may be more consequential for these student outcomes.

In other lines of research, scholars have compared outcomes such as educational attainment, achievement, and civic values between graduates from EP schools and graduates from other types of schools (Pennings et al., 2014; Van Pelt et al., 2012). Regarding STEM-related outcomes, these studies generally find that students who attend EP schools exhibit unique vocational patterns and attitudes towards science. For instance, Sikkink (2014) finds that postsecondary-school students who have graduated from EP high schools are more likely than other students to enroll in degree programs that prepare them for jobs in the health care and education sectors. Yet students from secular private and Catholic schools are more likely than students from EP schools to hold jobs in other STEM fields, especially engineering, physical science, and other more technical fields.

The reason for these patterns is not clear. One possibility is that negative dispositions towards scientism turn EP-school graduates away from pursuing careers in STEM. Indeed, Schwartz and Sikkink (2016) find that graduates of EP schools are relatively less likely than graduates from other school sectors to hold in high regard the contributions of scientists towards the public good. However, this hypothesis cannot explain why EP-school graduates are overrepresented in sectors such as health care where substantial training in science is required (Sikkink, 2014; Pennings et al., 2014). In fact, some studies document that the lower levels of educational attainment among the broader Protestant bloc are driven primarily by Pentecostals and fundamentalists — relatively more conservative subgroups who tend to isolate themselves from various social intuitions, including public schools (Beyerlein, 2004; Sikkink, 1999). Moreover, Schwartz and Sikkink (2016) find similar course-taking patterns for students in EP and other schools, further undermining the hypothesis that differences in interest in science explain these patterns. Nor are EP schoolers any more likely than individuals of other faith traditions to perceive their religious beliefs and science to be in conflict, even if they are more likely to ascribe a literalist account of creation rather than Darwin's theory of evolution. It appears that other socialization processes play a strong role in drawing students from EP schools into occupations that directly serve human needs, despite some conflicting attitudes towards science.

If so, one might ask what particular EP school practices are constitutive of these socialization process. Sociologists and philosophers have long recognized the important role that community-specific habits and social practices play in forming particular dispositions, conceptions of the good, understandings of what is possible, and guiding principles for moral actions and ends (Berger & Luckman, 1966; Guin, 2016; Hardin & Conley, 2001; MacIntyre 2007; Smith & Smith, 2011). Thus, the everyday practices that occur EP science classrooms may play a role in shaping student outcomes. Indeed, Hill (2014) finds evidence suggesting that the extent to which adolescents maintain their creationist beliefs over time is largely dependent upon whether they remain embedded in communities that share those beliefs.

Research Questions

In the analysis below, I compare educational emphases of science classrooms in EP schools with those of science classrooms in other school sectors. I also examine whether educational emphases in science classrooms is associated with STEM-related student outcomes and whether any cross-sector differences in these outcomes can be explained by cross-sector differences in educational emphases. I specifically consider the extent to which teachers emphasize (1) teaching basic content knowledge, (2) improving scientific reasoning skills, and (3) the real-world applications of science.

It is crucial to clarify that these measures of emphasis do not capture teaching practice in its entirety. Nevertheless, what teachers emphasize in their classrooms is constitutive of their practice, making it useful to examine teaching emphases to study teaching practice. Teaching practices in the school context include classroom procedures and policy as well as tacit social norms and habits that are embodied in everyday classroom life. Importantly, teaching practices are rooted in educational ends, and both educational ends and concomitant practices are upheld and conveyed through what teachers elect to emphasize in their classrooms. Thus, analyzing the extent to which teachers emphasize (1) teaching basic content knowledge, (2) improving scientific reasoning skills, and (3) real-world applications of science along with their bearing on student outcomes reveals something about teaching practice in general.

Three research questions and their respective hypotheses frame the study. First, how are the educational emphases of science teachers in EP, Catholic, secular private, and public schools similar or different? Given that many EP schools were established as bulwarks to secularization, their science classrooms may place greater emphasis on scientific reasoning skills so that their students are equipped with rational defenses of their beliefs, especially against Darwinian evolution and other claims or principles of scientism (Carper, 1983; Cox et al., 2007). Similarly, science teachers in EP schools may downplay many of the ways in which science is applicable in the labor market and other spheres of everyday life, given prevailing negative attitudes towards the ability of science to contribute to the common good (Schwartz & Sikkink, 2016).

Second, I test whether educational emphases are associated with a variety of student outcomes, such as (1) attitudes towards science, (2) subsequent science course-taking patterns, and (3) aspirations to enter a profession in a STEM field. Because teaching emphases shape student behavior and goals, one might expect to find such relationships. For instance, if teachers do not make explicit real-world connections and deemphasize the applicability of science, students may find science less useful and may be discouraged from further study or longer-term entry into a STEM field (King & Ritchie, 2010). Indeed, insofar as science teachers in EP schools hold lower views of scientific contributions, as Schwartz and Sikkink (2016) have documented in some EP communities, they may engage in emphases and other practices that lead students away from taking advanced science coursework or entering STEM careers. The negative views of teachers may also lower students' attitudes towards science, such as whether science is useful, particularly if little effort is made to help them negotiate conflicting claims between science and religion (Billingsley et al., 2016).

For the third and final research question, I ask whether differences in educational emphases across EP, Catholic, secular private, and public schools explain the cross-sector differences in STEM-related student outcomes — patterns which prior research has observed (Sikkink 2014; Pennings et al., 2014). Figure 1 depicts a conceptual model of this dynamic. On one hand, characteristics of school sector will directly influence student outcomes such as attitudes towards science, course-taking patterns, and college major choice. Some of this school-sector influence, however, may be indirectly channeled through the educational emphases found in their respective science classrooms. With teaching emphases and associated practices being defining attributes of the means and ends of educational institutions across school sectors, I hypothesize that differences in emphases will partially explain the distinct life trajectories of students from each sector. This possibility has not been empirically tested before. I turn to the data and methods of my analyses next.

≪Figure 1 Here ≫

Methods

Data

Data for this study come from the High School Longitudinal Study of 2009 (HSLS:09). These data comprise a nationally-representative sample of about 25,000 ninth graders in U.S. public and private schools. In the fall of the 2009-2010 school year, the U.S. Department of Education surveyed these students, their parents, math and science teachers, school counselors, and principals. The U.S. Department of Education conducted a follow-up survey during the students' eleventh-grade year in 2011 and another follow-up survey in the fall of 2013, a few months after the expected date of high school graduation. In this study, I utilize the information from all three waves of HSLS:09 provided by students who were enrolled in science classrooms during their ninth grade year. I link this student data with information that their ninth-grade science teachers provided in the initial wave of the survey. There are approximately 4,000 science teachers in the data.

Measures of Teacher Educational Emphasis

Science teachers in the HSLS:09 sample were asked to complete questionnaires that asked them for a variety of details about their science classes, their educational history, and demographic information. In particular, these teachers were asked to indicate whether they placed heavy, moderate, minimal, or no emphasis on achieving a list of 11 educational emphases in their science classrooms.[2] Again, these items are broadly divided into three primary emphases: (1) teaching basic content knowledge, (2) improving scientific reasoning skills, and (3) connecting course content to real-world applications. The first emphasis mainly deals with teaching basic or foundational scientific facts, definitions, and concepts. The second emphasis concerns education in higher-order or critical thinking skills. It includes conveying epistemic concepts in science, such as the nature of the scientific method and adjudicating claims based upon evidence. The third emphasis is focused the practicability of science. This emphasis is achieved by connecting course content to the history and to contemporary applications of science in everyday life and the labor market. The full list of 11 items and their factor loadings are shown in Table 1.

[2] One might question the accuracy of self-reported measures of teaching emphasis and any other self-reported measure for that matter. Issues such as social desirability bias are well known (Duckworth & Yeager 2016). However, prior research has shown that self-reports of teaching practice are valid and reliable measures of actual teaching practice. They are strongly correlated with other measures such as those based upon reports by students or trained classroom observers (Desimone et al., 2010; Koziol & Burns 1986; Reddy et al. 2015).

≪Table 1 here≫

The items generally loaded onto distinct factors, though there are exceptions. For instance, the item asking for teachers' emphasis on generating interest in science loads onto the emphasis of improving scientific reasoning and analytical skills, but it also marginally loads onto the emphasis of connecting content to applications and topics in everyday life. Due to these minor discrepancies, I computed a weighted average of responses to each of the 11 items based upon the factor model to create measures of teacher emphasis on each of the three primary educational emphases. To aid with interpretation, these measures of emphasis are standardized to have a mean equal to 0 and standard deviation equal to 1.

Student Outcome Measures

Attitudes toward Science. During the first two waves of data collection (i.e., the students' ninth- and eleventh-grade years), students completed self-reported scales measuring the extent to which they (1) perceived science is useful for their future and (2) identified themselves as a science person. I use the terms science utility and science identity to describe these respective constructs. Both scales across exhibited acceptable Cronbach's alpha levels of 0.87 and 0.75, respectively. Items for these two scales are shown in the appendix. Summary statistics for these attitudinal measures are shown in Table 2.

Educational Attainment in STEM. Also available in the data is information regarding the number of science credits the student earned in high school and whether the student only took basic versions of a science course or took advanced versions such as Advanced Placement or other specialized courses that are not required for high school graduation. Additionally, in the most recent wave of HSLS:09, students who enrolled in college provide information about whether they are majoring in a STEM field. Summary statistics for these attainment outcomes are shown in Table 2.

≪Table 2 Here ≫

Empirical Strategy

To answer the three research questions, I estimate a series of regression models where the unit of analysis is the student. Sampling weights are always included in the analyses so that results are nationally representative, and standard errors are clustered at the classroom level given that some students come from the same science classrooms. Linear regression models are always used for continuous dependent variables while logistic regression models are used whenever the dependent variable is binary, with coefficients expressed in terms of marginal changes in probability to ease interpretation.

Research Question 1: Comparing Educational Emphasis across Sectors. I begin by comparing the educational emphases in EP schools' science classrooms with the emphases in Catholic, secular private, and public schools' science classrooms.[3] I estimate regression models where the dependent variable is one of the three aggregated measures of teacher emphasis and the independent variables of interest are the indicators for school sector with EP schools as the omitted category. Coefficients are estimates of differences in the levels that EP-school students are exposed to (1) teaching basic content knowledge, (2) improving higher-order scientific skills, and (3) connecting content to practical applications and topics in everyday life, relative to students in other types of schools.

[3]One can also separate traditional public schools from other types of public schools such as magnet and charter schools. Patterns across these types of public schools are similar, so I present results without disaggregating these types of public schools. The data also identify a small set of Jewish and other religious schools but their sample sizes are too low to confidently draw any conclusions.

It is possible that certain teacher, classroom, or individual-student characteristics influence the content that teachers emphasize. To make cross-sector comparisons in teaching emphases that account for these possible confounding factors, I include controls for teacher-, classroom-, and student-level characteristics in the regression models. I control for the teacher's gender, race, educational attainment, postsecondary major, years of experience, certification level, and whether they had previously worked in a science related job prior to teaching. With respect to classroom-level characteristics, I include variables indicating the course that the teacher is teaching and the average achievement level of the teacher's classes. I also include controls for the urbanicity and US census region of the school. Regarding student characteristics, the models include variables for student gender, baseline test scores in math, race, household income, and parent education. Summary statistics for all control variables are shown in Table 2.

Research Question 2: Linking Educational Emphasis to Student Outcomes. I then turn to the second research question to investigate whether differences in educational emphases in science classrooms for all students explain differences in students' STEM-related outcomes, namely, attitudes towards science and attainment in science coursework. I estimate a series of regression models where the dependent variable is one of these outcomes and the key independent variables are the three measures of educational emphasis. These models again control for the full set of teacher-, classroom-, and student-level characteristics. In models where the dependent variable is an attitudinal measure, I control for baseline measures of those respective variables in addition to the standard set of teacher-, classroom-, and student-level control variables. Note that these indicator variables for school sector are not included in the model as the intent is to simply ascertain whether teaching practices are predictive of student outcomes for the full sample.

Research Question 3: Linking Cross-sector Differences in Teacher Emphases with Cross-sector Differences in Student Outcomes. Finally, I examine whether differences in educational emphases in science classrooms across school sectors explains differences in student outcomes across school sectors. This analysis proceeds in two steps. I first run a series of regression models that use school-sector indicator variables to predict student outcomes, while controlling for teacher-, classroom-, and student-level characteristics. I then estimate these same models but also include the three measures of educational emphases as independent variables. If school sector is (1) predictive of student outcomes in the first set of regressions and (2) then loses predictive power upon inclusion of the measures of educational emphases, while (3) the measures of educational emphases are predictive of student outcomes, then one can conclude that cross-sector differences in student outcomes are partially explained by cross-sector differences in educational emphases.

Results

Evangelical Protestant School Differences in Educational Emphasis

Results for the first research question are depicted in Table 3. As shown in the first column, Catholic, public, and secular-private science classrooms all appear to emphasize the teaching of basic content knowledge more than EP science classrooms. Although these differences are sizeable, it is important to note that none of these differences are statistically significant. Science teachers in Catholic schools, for example, rank 0.18 standard deviations higher in their emphasis on teaching basic content knowledge compared to science teachers in EP schools. Science teachers in public schools emphasize teaching basic content knowledge even more; they rank 0.31 standard deviations higher than teachers in EP schools.

However, there are differences in emphasis on improving scientific reasoning and analytic skills. These results are reported in column 2 of Table 3. Science teachers in public schools place less emphasis on improving scientific reasoning and analytic skills than their EP school counterparts. The difference is approximately 0.40 standard deviations. Meanwhile, science teachers in secular private schools students place greater emphasis on improving reasoning and analytic skills relative to their counterparts in EP schools. The difference is nearly 0.58 standard deviations. Both of these differences are sizeable and statistically significant at the 0.05 level.

The third column presents evidence that science teachers in EP schools emphasize making practical connections beyond the classroom to a much lesser degree than science teachers in all other school sectors. The difference relative to science teachers in Catholic and public schools are 0.59 and 0.64 standard deviations, respectively. Science teachers in secular private schools also place more emphasis on making real-world connections; the difference is 0.31 standard deviations but is not statistically significant.

≪Table 3 Here≫

Educational Emphasis and Student Outcomes

Attitudes towards Science. Table 4 displays results that speak to the second research question, namely whether educational emphases are predictive of student outcomes. The first two columns present results for the two attitudinal outcome measures: science utility and science identity. Educational emphases in science classrooms have little association with either of the student attitudes towards science as none of the coefficient estimates are statistically significant or substantively large.

≪Table 4 Here ≫

Educational Attainment in Science. In the latter three columns of Table 4, we observe results from regressions that test for relationships between educational emphases and attainment in science. Although there is no relationship between educational emphases and earned science course credits (columns 3), there is some evidence that an emphasis on improving scientific reasoning skills is associated with whether the student goes on to take advanced coursework in science (column 4). In other words, students who had science teachers that emphasized improving scientific reasoning skills were not more likely to take more science classes, but they did eventually complete the more advanced versions of the similar courses (e.g., AP physics rather than general physics). As depicted in column 4, every increase of one standard deviation in the level of emphasis on improving scientific reasoning and analytical skills raises the likelihood that students will complete advanced science coursework by 3.4 percentage points, all else equal.

In the final column of Table 5, we observe that students whose teachers emphasize making connections beyond the classroom are more likely to go on to enter college degree programs in the STEM fields. Increasing the measure of this emphasis by one standard deviation increases the likelihood that the student eventually decides to major in a STEM field by 2.5 percentage points, all else equal.

Cross-sector Differences in Teacher Emphasis and Cross-sector Differences in Student Outcomes

Thus far, we have observed differences in emphases in science classrooms between EP and other schools. We have also observed that variation in these emphases accounts for differences in some student outcomes. I now test whether the sector differences in student outcomes observed in prior research are attributable to differences in educational emphases as other researchers have suggested (Schwartz & Sikkink, 2016; Sikkink 2014; Pennings et al., 2014). Because the analyses earlier only found relationships between educational emphases and whether the student (1) completed advanced coursework in science or (2) decided to major in a STEM field, I explore this question only for these two outcomes.[4] Results are shown in Table 5.

≪Table 5 Here ≫

The first three columns of Table 5 show estimates pertaining to whether students complete advanced courses in science. The first column reproduces the results from Table 4, which use educational emphases to predict the completion of advanced science courses. The next column presents results that use school sector dummies and the full set of control variables to predict the same outcome. Students in EP schools are strikingly different from their peers in secular private schools. The latter are about 31 percentage points more likely than the former to complete advanced courses in science — a finding also documented by Schwartz and Sikkink (2016). When measures of educational emphasis and school sector dummies are estimated jointly, patterns of statistical significance do not change substantially, indicating that a greater emphasis on improving scientific reasoning skills is not likely to be the reason behind the higher rates of completing advanced science courses in secular private schools as compared to EP schools. In other words, the secular private school advantage is likely attributable to some other unobserved factor net of the measured educational emphases and the control variables.

Column 4 through column 6 show analogous results for whether students begin a postsecondary degree program in a STEM field. As shown here in column 4 and previously in Table 4, students who enroll in college more likely begin a degree program in a STEM field if their science teachers placed greater emphasis on making real-world connections. The next

[4] Results for the other dependent variables are available upon request from the authors.

column displays school-sector differences in this outcome. Consistent with Sikkink (2014) and Pennings et al. (2014), Catholic- and public-school students appear 10 and 8 percentage points more likely than EP students to enter a STEM degree program, respectively. However, as shown in column 6, including measures of educational emphases causes these sector differences to fall to 8 and 5 percentage points. That is, between one-fifth and one-third of the association between college major and school sector is attributable to cross-sector differences in classroom educational emphasis. In particular, the coefficient for educational emphasis on making real-world connections is robust to the inclusion of school sector variables. In sum, these patterns suggest that the lower tendency for EP school graduates to enter degree programs in STEM may stem from the lower emphasis that science teachers in EP schools place on connecting course content to applications and concepts in industry, business, and other areas of society outside the classroom.

Discussion and Conclusion

Recent calls have been made for EP schools to critically reflect upon how their teaching practices are unique and informed by their religious beliefs and traditions as well as how such practices might affect the students whom they serve and the common good more broadly (Green, 2016; Smith et al., 2014; Smith, & Smith, 2011). Although such critical reflection requires taking stock of current practices, little is known about what systematically occurs in EP classrooms. The few exceptions of research on this topic suggest little distinction between EP schools and public schools (Burton, 1998; Burton et al., 2004). However, measures of teaching practice in this research may be too unrefined to find differences, and given that qualitative studies of individual EP schools describe a distinctive ethos within these schools, it is reasonable to question claims of few differences in practices across school sectors (Bryk et al., 1993; Sikkink, 2001).

This study examines teaching practices in EP schools by comparing educational emphases of science teachers in EP schools with those of science teachers in other types of schools. Using a nationally-representative sample of high school students, I find that science teachers in EP schools place stronger emphasis on improving scientific reasoning and analytical skills than science teachers in public schools but place weaker emphasis on this matter relative to science teachers in secular private schools. More strikingly, science teachers in EP schools place much less emphasis than teachers in Catholic and public schools on making real-world connections. There are clear distinctions in the treatment of science between teachers in EP schools and teachers in other types of schools. It would be useful for subsequent research to further explore these systematic patterns and to flesh out classroom practices in greater detail.

I additionally show that teaching emphases measured in the data are associated with some STEM-related student outcomes. Regardless of school sector, if students are taught by teachers who particularly focus on connecting science course content to real-world applications, they are more likely to enter a degree program in a STEM field upon postsecondary matriculation. Introducing students to the practical side of science may motivate them to pursue careers that regularly apply scientific knowledge (King & Ritchie, 2010).

Furthermore, students who experience classrooms that focus on fostering scientific reasoning skills are more likely than their counterfactual peers to complete advanced coursework in science, even if they ultimately take similar amounts of science coursework by graduation. This finding may reflect the kind rigorous preparation found in introductory-level courses designed for students on tracks that progress onto more advanced studies. This is an empirical question, and finer-grained comparisons of science curricula would provide more insight to better understand such science course-taking patterns.

The relationships between educational emphasis and student outcomes raise important questions for teaching and learning in EP schools, especially if EP schools tend to place less emphasis on connecting science content to applications in industry, business, and other sectors of society. The evidence, though not causal, does suggest that future research should continue to explore the ways in which teaching and learning practices in EP schools affect their students. Indeed, the final set of results in this study indicate that the lower propensity of EP school graduates to major in a STEM field in college — a finding also documented by Sikkink (2014) and Pennings et al. (2014) — may partially be attributable to the lower emphasis that EP science teachers place on making real-world connections with the science content.

Exact reasons behind the lower emphasis on the practicability of science in EP classrooms are less clear. Prior literature has documented the uniquely less favorable perceptions of science among EP communities and their bearing upon educational attainment or opinions on the contribution of scientists (Beyerlein, 2004; Evans, 2011; 2013; Evans & Feng, 2013; Schwartz & Sikkink 2016). The lower emphasis on the applications of science in EP schools might reflect these less favorable attitudes towards science. Relatedly, the greater emphasis on scientific reasoning in EP schools might reflect the widespread teaching of critical thinking about evolution or scientism (Cox et al., 2007). However, teaching emphases bore no relationship with students' self-reports of the utility of science and whether they self-identified as a science person, undermining the proposition that EP schoolteachers are instilling a negative outlook on science through their de-emphasis on the applications of science. Further exploration of the ways in which EP schools downplay the application of science and reasons for doing so will be useful for reflecting on teaching practices in EP science classrooms.

In their recent article, Schwartz and Sikkink (2016) urged research efforts to “unlock the black-box of scientific instruction in evangelical schools” to better understand the ways in which schools shape their students (p. 18). The role of the educational emphases within science classrooms across school sector suggests that teaching practices unique to school sectors partially account for differences in their longer-run student outcomes. Granted, this analysis did not find evidence that cross-sector differences in educational emphases was associated with cross-sector differences in other outcomes aside from entering degree program in a STEM field. At any rate, additional scholarly exploration of EP and other types of schools may shed additional light on the black box of their educational practices. Both research describing teaching and learning practices on a large scale, as this study has done, and scholarship providing finer-grained pictures of particular communities are encouraged. While this study relied only upon the educational experience of students’ ninth-grade science teachers, subsequent research could also leverage year-to-year changes in educational emphases that individual students experience to map out the other formative factors. The extent to which experiences from science classrooms in other years, not to mention experiences in other spaces of EP schools beyond the science classroom, affect student outcomes is worth additional examination.

Patterns uncovered in this study also raise questions for science teachers in EP schools and other practitioners. Teaching and learning practices are not inconsequential. They have the potential to shape the life trajectories of students. For this reason, it may behoove teachers to regularly and purposefully reflect upon their educational practices, the ways in which they may affect students, and the ultimate ends of a science education (DeYoung, 2011). For example, if deemphasizing the connections and applicability of science in work, everyday life, and the pursuit of the common good tends to divert students away from the STEM fields, how can teachers alter their practice to reverse the trend, especially for students who have vocations that involve entering the STEM fields? How can teachers encourage better stewardship of scientific knowledge by recognizing both its limits and its potential to promote the common good? To what extent are these goals worth pursuing? Although the findings in this study speak primarily to the science curriculum, teachers of content areas besides science will find value in asking similar questions for their own respective content areas. Answers to these questions are not immediately obvious, but EP schools need to pursue them to understand the way they influence their families and communities, while also imagining how to serve them more effectively.

References

Astley J and Francis LJ (2010) Promoting positive attitudes towards science and religion among sixth-form pupils: dealing with scientism and creationism. *British Journal of Religious Education* 32(3): 189-200.

Barbour I (1990). *Religion in an age of science: The Gifford Lectures 1989–1991*. San Francisco: Harper and Row.

Berger PL and Luckmann T (1966) *The social construction of reality*. New York: Penguin Books.

Berkman M, Pacheco JS and Plutzer E (2008) Evolution and creationism in America's classrooms: A national portrait. *PLOS Biology* 6(5): e124.

Berkman M and Plutzer E (2010) *Evolution, creationism, and the battle to control America's classrooms*. New York: Cambridge University Press.

Beyerlein K (2004) Specifying the impact of conservative Protestantism on educational attainment. *Journal for the Scientific Study of Religion* 43(4): 505-518.

Billingsley B (2013) Students' perceptions of apparent contradictions between science and religion: Creation is only the beginning. In Mansour N and Wegerif R (eds) *Science Education for Diversity*. Dordrecht: Springer, pp. 329–338.

Billingsley B, Brock R, Taber KS and Riga F (2016) How students view the boundaries between their science and religious education concerning the origins of life and the universe. *Science Education* 100(3): 459-82.

Billingsley B, Riga F, Taber KS and Newdick H (2014) Secondary school teachers' perspectives on teaching about topics that bridge science and religion. *The Curriculum Journal* 25(3): 372-395.

Brickhouse NW, Daghe, ZR, Letts WJ and Shipman HL (2000) Diversity of students' views about evidence, theory, and the interface between science and religion in an astronomy course. Jo*urnal of Research in Science Teaching* 37(4): 340-62.

Bryk AS, Lee VE and Holland PB (1993) *Catholic schools and the common good*. Cambridge: Harvard University Press.

Burton LD (1998) Instructional patterns in science: An exploratory study. *Journal of Research on Christian Education* 7(1): 37-54.

Burton LD, Nino RJ and Hollingsead CC (2004) Science classrooms of a selected Seventh-day Adventist conference. *Journal of Research on Christian Education* 13(1): 99-129.

Carper JC (1983) The Christian Day School movement. *The Educational Forum* 47(2): 135-149.

Cheng A, Trivitt JR and Wolf PJ (2016) School choice and the branding of Milwaukee Private Schools. *Social Science Quarterly* 97(2): 362-375.

Coyne JA (2012) Science, religion, and society: The problem of evolution in America. *Evolution* 66(8): 2654-2663.

Cox WF, Hameloth NJ and Talbot DP (2007) Biblical fidelity of Christian school textbooks. *Journal of Research on Christian Education*, 16(2): 181-210.

Dávila D (2014) When discourses collide: Creationism and evolution in the public sphere. *Cultural Studies of Science Education* 9(4): 877-84.

Desimone L, Smith T and Frisvold D (2010) Survey measures of classroom instruction: Comparing student and teacher reports. *Educational Policy 24*(2): 267–329.

DeYoung RK (2011). Pedagogical rhythms: Practices and reflections on practices. In Smith D and Smith JKA (eds): *Teaching and Christian Practices: Reshaping Faith and Learning*, pp. 24-42. Grand Rapids: Wm B. Eerdmans Publishing Co.

Duckworth A and Yeager D (2015) Measurement matters: Assessing personal qualities other than cognitive ability for educational purposes. *Educational Researcher* 44(4): 237-251.

Evans JH (2011) Epistemological and moral conflict between religion and science. *Journal for the Scientific Study of Religion* 50(4): 707-727.

Evans JH (2013) The growing social and moral conflict between Conservative Protestantism and science. *Journal for the Scientific Study of Religion* 52(2): 368-385.

Evans JH and Feng J (2013) Conservative Protestantism and skepticism of scientists studying climate change. *Climatic Change 121*(4): 595-608.

Gauchat G (2012) Politicization of science in the public sphere: A study of public trust in the United States, 1974 to 2010. *American Sociological Review* 77(2): 167-187.

Green B (2016) Entrances, exits: Christian education and the future. *International Journal of Christianity and Education* 20(3): 181-185.

Griffith JA and Brem SK (2004) Teaching evolutionary biology: Pressures, stress, and coping. *Journal of Research in Science Teaching* 41(8): 791-809.

Guin J (2016) Why worry about evolution? Boundaries, practices, and moral salience in Sunni and Evangelical high schools. *American Sociological Association* 34(2): 151-174.

Harris SJ (2002) Roman Catholicism since Trent. In Ferngren GB (ed) *Science and Religion: A Historical Introduction*. Baltimore: Johns Hopkins University Press, pp. 247–260.

Hanley P, Bennett J and Ratcliffe M (2014) The inter-relationship of science and religion: A typology of engagement. *International Journal of Science Education* 36(7): 1210-1229.

Hardin CD and Conley TD (2001) A relational approach to cognition: Shared experience and relationship affirmation in social cognition. In Moskowitz GB (ed) *Cognitive Social*

Psychology: The Princeton Symposium on the Legacy an Future of Social Cognition. Mahwah: Lawrence Erlbaum Associates Inc, pp. 3-17

Hill JP (2014) Rejecting evolution: The role of religion, education, and social networks. *Journal for the Scientific Study of Religion* 53(3): 575-594.

Isch J (2002) The generation to come: Lutheran education in the United States. *Catholic Education: A Journal of Inquiry and Practice* 5(4): 527-440.

King, D and Ritchie SM (2010). Learning science through real-world contexts. In Fraser BJ, Tobin K and McRobbie CJ (eds) *Second International Handbook of Science Education.* New York: Springer, pp.69-79

Knight G (2006) *Philosophy and education: An introduction in Christian perspective*. Berrien Springs: Andrews University Press.

Koziol SM and Burns P (1986). Teachers' accuracy in self-report about instructional practices using a focused self-report inventory. *The Journal of Educational Research* 79: 205-209.

Longest, KC and Smith, C (2011). Conflicting or compatible: Beliefs about religion and science among emerging adults in the United States. *Sociological Forum* 26(4): 846-869.

MacIntyre A (2007) *After Virtue: A Study in Moral Theory*. Notre Dame: University of Notre Dame Press.

Miller JD, Scott EC and Okamoto S (2006) Public acceptance of evolution. *Science* 313(5788): 765-766.

Moore R and Kraemer K (2005) The teaching of evolution and creationism. *The American Biology Teacher* 67(8): 457-466.

Noll MA (2002) *The old religion in a new world: The history of North American Christianity*. Grand Rapids: Eerdmans.

Pennings R, Sikkink D, Berner A, Smith C, Berends M, Dallavis J and Skiles S (2014) *Cardus Education Survey: 2014 Report*. Hamilton, ON: Cardus.

Reddy LA, Dudek CM, Fabiano GA and Peters S (2015) Teacher self-report on classroom practices: Construct validity and reliability of the classroom strategies scale – Teacher Form. *School Psychology Quarterly* 30(4): 513–533.

Reichard JD (2016) No “slippery slope”? An empirical case study of the effect of secular science textbooks on student religiosity in a Christian private school. *Journal of Research on Christian Education* 25(1): 25-37.

Rutledge ML and Mitchell MA (2002) High school biology teachers’ knowledge structure, acceptance and teaching of evolution. *The American Biology Teacher* 64(1): 21-28.

Schwartz J and Sikkink D (2017) Blinded by religion? Religious school graduates and perceptions of science in young adulthood. Notre Dame: Cardus Religious Schools Initiative, University of Notre Dame.

Sikkink D (1999). The social sources of alienation from public schools. *Social Forces* 78(1): 51-86.

Sikkink D (2001) Speaking in many tongues. *Education Next* 1(2): 36-44.

Sikkink D (2014) What is your major? Occupational trajectories of graduates of religious schools. Notre Dame: Cardus Religious Schools Initiative, University of Notre Dame.

Smith DI, Um J and Beversluis CD (2014) The scholarship of teaching and learning in a Christian context. *Christian Higher Education* 13(1): 74-87.

Smith DI and Smith JKA (2011) Introduction: Practices, faith, and pedagogy. In Smith D and Smith JKA (eds): *Teaching and Christian Practices: Reshaping Faith and Learning*, pp. 1-23. Grand Rapids: Wm B. Eerdmans Publishing Co.

Taber KS, Billingsley B, Riga F and Newdick H (2011) Secondary students’ responses to perceptions of the relationship between science and religion: Stances identified from an Interview Study. *Science Education* 95(6): 1000-1025.

Trivitt JR and Wolf, PJ (2011) School choice and the branding of Catholic schools. *Education Finance and Policy* 6(2): 202-245.

Van Brummelen HW (2009) *Walking with God in the classroom: Christian approaches to teaching and learning*. Colorado Springs, CO: Purposeful Design Publications.

Van Pelt DA, Sikkink D, Pennings R and Seel J (2012) Private religious Protestant and Catholic schools in the United States and Canada: Introduction, overview, and policy implications. *Journal of School Choice* 6(1): 1-19.

Winslow MW, Staver R and Scharmann LC (2011) Evolution and personal religious belief: Christian university biology-related majors’ search for reconciliation. *Journal of Research in Science Teaching* 48(9): 1026-1049.

Yasri P and Mancy R (2014) Understanding student approaches to learning evolution in the context of their perceptions of the relationship between science and religion. *International Journal of Science Education* 36(1): 24-45.

Table 1: Educational Emphases of Science Teachers and their Factor Loadings

	Teaching basic content knowledge	Improving scientific reasoning and analytical skills	Making connections beyond the classroom
Teaching students basic science concepts	0.687*	0.299	-0.119
Teaching students important terms and facts of science	0.775*	0.080	0.127
Preparing students for standardized tests	0.612*	-0.209	0.236
Teaching students to evaluate arguments based on scientific evidence	-0.007	0.708*	0.325
Teaching students science process or inquiry skills	0.103	0.775*	0.097
Teaching students how to communicate ideas in science effectively	0.072	0.675*	0.300
Preparing students for further study in science	0.165	0.648*	0.227
Increasing students' interest in science	0.034	0.493*	0.382
Teaching students about the applications of science in business and industry	0.030	0.180	0.811*
Teaching students about the history and nature of science	0.259	0.254	0.602*
Teaching students about the relationship between science, technology, and society	0.046	0.204	0.826*

Note: An exploratory principal components factor analysis and varimax rotation were used to compute factor loadings. Asterisks identify the primarily factor loading of each item.

Table 2: Summary Statistics

	Mean	Standard Deviation	Minimum	Maximum
Student Outcome Measures				
Utility of Science Scale in 11th Grade	3.04	0.64	1.00	4.00
Science Identity Scale in 11th Grade	2.41	0.91	1.00	4.00
High School Science Credits Earned	3.23	1.29	0	12.00
Completed Advanced Science Coursework	0.55	0.50	0	1
Majoring in a STEM Field	0.24	0.43	0	1
School Sector Variables				
EP School	0.02	0.13	0	1
Catholic School	0.04	0.20	0	1
Public School	0.93	0.26	0	1
Secular Private School	0.02	0.12	0	1
Teacher-Level Control Variables				
Male	0.43	0.50	0	1
White	0.86	0.35	0	1
Has Master's Degree or Above	0.55	0.50	0	1
Majored in STEM field	0.57	0.49	0	1
Years of Experience	7.82	7.37	1	48
Holds Teaching Certification	0.80	0.40	0	1
Held STEM job prior to teaching	0.35	0.48	0	1
Classroom-Level Control Variables				
Course				
General Science	0.58	0.49	0	1
General Biology	0.37	0.48	0	1
Other Science Course	0.05	0.23	0	1
Percent of Student Unprepared for Current Course				
25% or less	0.62	0.49	0	1
26% to 50%	0.26	0.44	0	1
51% to 75%	0.10	0.30	0	1
More than 75%	0.03	0.16	0	1
Achievement Level of Class Relative to Average 9th Grade Student				
Higher	0.26	0.44	0	1
About the Same	0.45	0.50	0	1
Lower	0.14	0.35	0	1
Mixed	0.15	0.36	0	1

Notes: Sampling weights used to compute summary statistics.

Table 2: Summary Statistics (Continued)

	Mean	Standard Deviation	Minimum	Maximum
Census Region				
New England	0.07	0.26	0	1
Middle Atlantic	0.11	0.31	0	1
East North Central	0.18	0.38	0	1
West North Central	0.07	0.26	0	1
South Atlantic	0.18	0.38	0	1
East South Central	0.07	0.25	0	1
West South Central	0.12	0.33	0	1
Mountain	0.06	0.23	0	1
Pacific	0.14	0.35	0	1
Locale	0.32	0.47	0	1
Urban	0.33	0.47	0	1
Suburban	0.12	0.32	0	1
Town	0.23	0.42	0	1
Rural	0.32	0.47	0	1
Student-Level Control Variables				
Male	0.50	0.50	0	1
Baseline Math Test Scores	0.00	1.00	-2.61	2.95
Baseline Utility of Science Scale	2.92	0.62	1.00	4.00
Baseline Science Identity Scale	2.50	0.87	1.00	4.00
Student Race				
Hispanic	0.20	0.40	0	1
White	0.55	0.50	0	1
Asian	0.04	0.19	0	1
Black	0.13	0.34	0	1
Other Race	0.09	0.28	0	1
Log of Household Income	10.86	0.95	8.92	12.37
Parent Education				
Less than High School	0.07	0.25	0	1
High school or GED	0.33	0.47	0	1
Associate's Degree	0.23	0.42	0	1
Bachelor's Degree	0.22	0.42	0	1
Post-Baccalaureate Degree	0.11	0.32	0	1

Notes: Sampling weights used to compute summary statistics.

Table 3: Differences in Educational Emphases of EP Science Teachers Relative to Other Science Teachers

	(1) Teaching basic content knowledge	(2) Improving scientific reasoning skills	(3) Making real-world connections
Catholic	0.178 (0.251)	-0.123 (0.187)	0.592* (0.246)
Public	0.311 (0.248)	-0.402* (0.174)	0.637** (0.230)
Secular Private	0.042 (0.337)	0.575* (0.245)	0.311 (0.375)
R^2	0.084	0.167	0.112
Sample size	6,910	6,910	6,910

Notes: Regression models control for full set of teacher-, classroom-, and student-level control variables. Omitted category are EP schools. Sampling weights included. Standard errors clustered at the teacher level. All units are expressed in standard deviations. Sample sizes are rounded to the nearest 10 per data-use agreement. **p<0.01, *p<0.05

Table 4: Educational Emphases and Student Outcomes

	Attitudinal Measures		Attainment Outcomes		
	(1) Science Utility	(2) Science Identity	(3) Science Credits Earned	(4) Completed Advanced Science Coursework	(5) Majoring in a STEM Field
Teaching basic content knowledge	-0.001 (0.016)	-0.010 (0.015)	0.008 (0.0215)	0.001 (0.011)	0.000 (0.009)
Improving scientific reasoning skills	-0.008 (0.018)	0.012 (0.017)	0.001 (0.023)	0.034** (0.012)	-0.015 (0.009)
Making real-world connections	0.028 (0.018)	0.015 (0.016)	-0.003 (0.022)	0.015 (0.012)	0.025** (0.009)
R^2 or Pseudo-R^2	0.148	0.349	0.219	0.059	0.131
Sample size	6,260	7,120	6,370	6,370	4,440

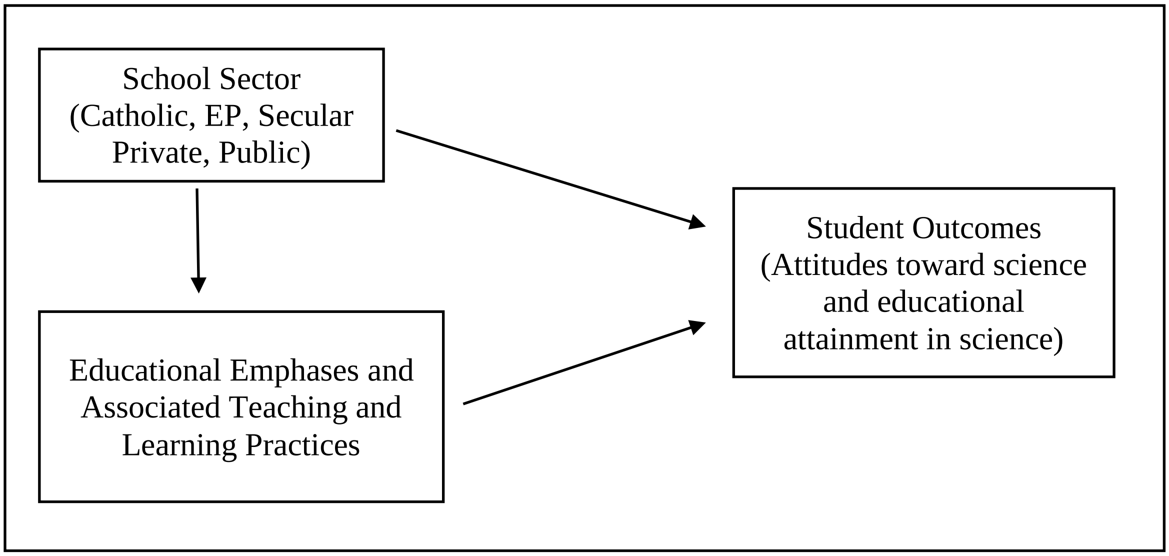
Notes: Regression models control for full set of control variables. Coefficients for the last two columns are marginal effects. Omitted category are EP schools. All units are expressed in standard deviations. Sample sizes are rounded to the nearest 10 per data-use agreement. **$p<0.01$, *$p<0.05$

Table 5: Relationships between Educational Emphases, School Sector, and Student Science Attainment Outcomes

	Completed Advanced Science Courses			Majoring in a STEM Field		
	(1)	(2)	(3)	(4)	(5)	(6)
Teaching basic content knowledge	0.001		0.005	0.000		0.001
	(0.011)		(0.012)	(0.009)		(0.009)
Improving scientific reasoning skills	0.034**		0.033**	-0.015		-0.010
	(0.012)		(0.012)	(0.009)		(0.009)
Making real-world connections	0.015		0.022	0.025**		0.027**
	(0.012)		(0.013)	(0.009)		(0.009)
Catholic School		0.053	0.040		0.100*	0.080
		(0.085)	(0.088)		(0.045)	(0.045)
Public School		0.067	0.065		0.078*	0.054
		(0.080)	(0.084)		(0.039)	(0.039)
Secular Private School		0.306**	0.286*		0.071	0.060
		(0.113)	(0.117)		(0.061)	(0.063)
R^2 or Pseudo-R^2	0.059	0.058	0.061	0.131	0.130	0.134
Sample size	6,370	5,960	5,960	4,440	4,150	4,150

Notes: Regression models control for full set of control variables. Omitted category are EP schools. Coefficients are marginal effects. Sampling weights included and standard errors clustered at the classroom level. Sample sizes are rounded to the nearest 10 per data-use agreement. **p<0.01, *p<0.05

Figure 1: Conceptual Model for the Relationship between School Sector, Educational Emphasis, and Student Outcomes



Notes: Each school sector has direct impacts on student outcomes. However, the idiosyncrasies of each school sector may also influence the nature of the educational emphases and other teaching practices. Cross-sector differences in student outcomes may be channeled indirectly through differences in educational emphases.

Appendix
Items for Attitudinal Scales

Utility of Science Scale Items

How much do you agree with the following statements about science? (Response options: Strongly agree, agree, disagree, strongly disagree).

1. Science is useful for everyday life
2. Science is useful for college.
3. Science is useful for a future career.

Science Identity Scale Items

How much do you agree or disagree with the following statements? How much do you agree with the following statements about science? (Response options: Strongly agree, agree, disagree, strongly disagree).

1. I see myself as a science person
2. Others see me as a science person.