Relating Christian Faith to Physics for Scientists and Engineers

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Abstract

As part of an initiative by the new Center for Faith and Learning at Oral Roberts University, an introductory college-level physics course for scientists and engineers is being reconfigured to facilitate the integration of physics and Christian faith. Regular readings from a popular book, *Einstein and Religion*, by Max Jammer, on the compatibility between physics and Christian doctrine are assigned. Questions based on the readings are posed and a small fraction of class time (10%) is reserved for discussion of these issues. The students also submit book reports summarizing their perspectives at the end of the course. A detailed rubric is developed to guide the process of faith and learning integration. Pre and post-course assessment surveys are administered in an attempt to quantify the extent of faith and learning integration. Results are presented and the success of this faith and learning integration project is discussed.

The objective is to equip students to serve others spiritually, through wisdom and knowledge of the relationship between physics and Christianity, while not compromising or diminishing their ability to serve others materially, through in-depth understanding and skill in science and engineering. It is believed that the time devoted to the integration of faith and physics is well-spent, in that it serves to motivate the students to achieve their God-given calling to be a well-informed Christian who is also an excellent scientist or engineer. Students recognize the need to articulate this kind of science/faith integration in society, among both believers and unbelievers. They see this as an important aspect of their stewardship of vital resources, creativity, and information that God has provided for the benefit of mankind. As such, they are enthused and excited to positively respond to God's invitation to partner with him in accomplishing his purposes on the earth, both materially and spiritually.

Introduction to Faith and Learning

How does God relate to academics? More specifically, how does God relate to physics and engineering? College students today are hungry for relevance and the application of learning to real-life [1][2] and, therefore, are not easily satisfied with doctrinal answers that are not clearly aligned to real-life situations. Because of students' hunger for relevance, *Faith and Learning Integration* (FLI) is pertinent to Christian higher education [3][4][5][6][7] in assisting students to practice Christ-likeness in their future life and professions [8]. At all age levels, effective teaching should help students make the connections between academics and real-world problems [9]. Likewise, the Christian professor must help students understand that there should be no compartmentalization of faith separate from academic and professional beliefs and practice [10].

FLI is defined as "a scholarly project whose goal is to ascertain and to develop integral relationships which exist between Christian faith and human knowledge . . . in the various academic disciplines" [11]. For the sake of this study, faith and learning integration is *the intentional consistent presentation of the relationship between biblical reasoning and academic research*. In the areas of physics and engineering, FLI is concerned about the intentional and consistent presentation of the relationship between biblical principles and academic research in physics, primarily for students majoring in engineering. Students might wonder, "How, if at all, does the Bible apply to the study of physics, in a way that prepares me to be a better engineer?" The goal of FLI in physics and engineering will not limit itself to what students know, but also to what they believe to be true, and with what they do with their knowledge and beliefs ("What constitutes appropriate stewardship of natural resources?").

The plethora of research regarding faith and learning integration in Christian education confirms the importance of FLI to Christians during the past half-century [12][13][14][15][16][17][18][19][20]. While there are multiple approaches to FLI integration,

> Those involved in Christian higher education must be intentional about integrating faith and learning in every discipline. . . . The goal is to enable men and women to be prepared for their chosen vocation in such a way that they can be salt and light in the marketplace. The goal of these programs is to help students become servant leaders and change agents in our world [21].

Likewise, the objective of this paper and the research supporting it is to equip students to help others by applying Christian faith to the study of physics and engineering.

Faith and Learning in Science and Engineering

According to David Claerbaut (2004), "The challenge for the Christian in the physical sciences is this: to seek and find God's wisdom and truth in nature, and to impart it to others" [22]. For the Christian student in science or engineering, this includes developing an understanding of how their newly acquired technical knowledge, and God-given talents for discovery and problem solving, can assist others in forming a deeper knowledge of, and relationship with, God. Mark Bolyard writes that, as a mentor and instructor of Christian college students in the sciences, his role is to lead students to first become "question askers," and then "question answerers." He continues, "I also try to ask questions that will force students to examine the information that I present from a Christian context" [23]. Bolyard emphasizes the importance of examining philosophical assumptions and implications:

> When, however, we ask what difference being a Christian "should" make in the practice of science, a Christian should be open to the real possibility that the paradigms within which science operates, within his or her own specialty, might be rooted in assumptions that are contrary to the Christian understanding of the world. So, while Christians should be scientific practitioners, they should also be philosophers of science [24].

As an example, one obvious question that comes up is the adequacy of methodological naturalism as an overarching scheme for practicing science and interpreting scientific discoveries. Recent work by the author argues that reverse engineering projects in systems biology may be enhanced by metaphysical considerations [25]. This is particularly important when considering possible explanations for apparent genomic malfunctioning that causes considerable suffering and death. Alvin Plantinga (2011) provides the following insight, "What we need here, of course, is not natural science, but a broader inquiry that can include all that we know, including truths that God has created life on earth and could have done it in many different ways" [26]. This might also include the possibility that God would allow his creatures to experience corruption and damage, in order for some future greater good to be realized.

Philosophical assumptions and implications also arise in physics. Jeanette Russ points out the connection between time dilation in Einstein's theory of relativity and "the biblical description of God as light with the knowledge that he exists outside of time" [27]. Although we should be careful not to take this biblical metaphor out of context, it is widely recognized in science and religion studies that Einstein's work has interesting implications for theology. Russ also indicates that several early scientists, such as Galileo, Pascal, and Newton not only recognized the philosophical implications of their work, but also recognized the practical implications, and practiced engineering by applying their discoveries to solve problems and create new devices. Stephen Hawking, in his book *A Brief History of Time (1988),* discusses the philosophical implications of the initial conditions of the universe in very frank terms,

> This means that the initial state of the universe must have been very carefully chosen indeed if the hot big bang model was correct right back to the beginning of time. It would be very difficult to explain why the universe should have begun in just this way, except as the act of a God who intended to create beings like us [28].

This general recognition of the pervasive *fine-tuning* (the author prefers the term *engineering*) of the universe for life is probably the most interesting finding of twentieth century science, when it comes to philosophical implications regarding humanity's place in the universe. Recent data from the Planck space telescope continue to confirm this picture of an engineered universe [29], with further details regarding the minute fluctuations in the cosmic microwave background radiation. "The fluctuations can be thought of as seeds for all the [life-supporting] structure that later developed in the cosmos – all the stars and galaxies" [30]. This concept of "seeds" and intermediate states of matter that preceded the formation of our solar system has been found helpful for students' in evaluating the various proposed creation scenarios. Of course, the integration of faith and learning in engineering involves more than just exploring the connections between physics and theology. It also involves the idea that humans are made in God's image, but have fallen into sin, and are in need of redemption, as well as ethics, and stewardship in design and engineering. However, this project focuses on the integration of physics and Christian faith in first-year engineering students.

The most applicable reference for this work was found to be Sean Cordry's article (2007) on a pedagogical approach to integrating science/faith/origins (SFO) into college-level introductory physics courses at a Christian college. This article appeared in the December, 2007 issue of the Journal of the American Scientific Affiliation, *Perspectives on Science and Christian Faith* [31]. It details his experiences in teaching both stand-alone SFO courses, and (more pertinent to this paper) courses such as introductory physics, where SFO concepts are integrated into the standard academic material. Cordry discusses three approaches to achieve this integration: (1) readings from auxiliary texts, (2) student "journaling," and (3) presenting limited topical lectures. Although he found the third approach to be the most effective, the author has chosen to implement a loose combination of all three approaches in attempting a similar integration in a first-year (one-semester) physics course for engineering majors at Oral Roberts University (ORU). Cordry chose to "sprinkle" six short introductory topical SFO lectures throughout his (two-semester) physics course on the following subjects (and goals):

1. Erroneous Explanations of Nature in the Bible (Biblical explanations of nature reflect the worldview of the time.)
2. Formless and Void (The first creation narrative in Genesis provides an ancient taxonomic description of nature.)
3. Chaos and Parameter Sensitivity (Small changes in initial conditions can lead to big differences down the road.)
4. Anthropic Coincidences (The universe appears to be fine-tuned or engineered specifically for life.)
5. Infinite Unobservables (We must choose between a single infinite unobservable, or an infinite number of unobservables.)
6. Layer by Layer; Decay by Decay (The physical evidence for an old earth is significant and robust.)

This was quickly recognized to be too much material to try to cover in a one-semester physics course. It also seemed to stray considerably from the topic of physics. It was decided that this extra material should be reduced by about half, focusing mainly on fine-tuning, reverse engineering of natural systems, and cosmology, and to stick closer to the connections between physics and theology, as will be described in the next section.

Einstein and Religion: Exploring Connections between Physics and Theology

In an effort to introduce the engineering students at ORU to someone they could perhaps relate to, who has also wrestled with issues at the interface science and faith, they were required to read *Einstein and Religion: Physics and Theology* by Max Jammer [32]. This was in addition to the regular required

readings and problem assignments from their physics textbook [33]. However, Jammer's book is only 265 pages long, which amounts to about 20 (small – only about 250 words/page) pages per week. Albert Einstein is probably the best known and most respected scientist of the twentieth century. Virtually every student has heard of him and knows something of his momentous scientific work. But surprisingly few seem to be aware of the philosophical implications or his work, or the fact that he also made presentations and produced publications on issues in science and religion.

Besides a brief introduction, *Einstein and Religion (1999)* is divided into three sections. The first section deals with his early years and the role of religion in his private life. This section allows the students to get to know him on a more personal level, and relate to events in his life that occurred at an age that is similar to their own. Upon learning that Einstein was raised as a Jew, but attended Catholic schools growing up, one student shared how he could relate to Einstein's minority position since he was a Catholic attending ORU, which is mainly Protestant and charismatic. The student seemed to find this fact somewhat comforting. The second section discusses Einstein's philosophy of religion, which many students find challenging, and even troubling. Einstein recognized a higher power behind the order, beauty, and mathematical elegance of nature. But, apparently he could not accept the idea of a personal God who is involved in the everyday lives of human beings. Even so, the students picked up on several inconsistencies on this issue, where Einstein is quoted as referring to God in personal language. Students are challenged to come to terms with the religious views of an obviously extremely intelligent person who has come to conclusions about God that are probably very different from their own. The third section explores the connections between Einstein's scientific work and theology. Although this section gets into areas of physics that many first-year engineering students have not had (such as relativity, quantum mechanics, and big bang cosmology), Jammer usually brings the concepts down to their level and entices them into future study in these areas.

As mentioned earlier, this auxiliary reading is combined with writing assignments and small but regular portions of class time centered on the book. The students have multiple reasons to keep up with the daily reading assignments. The first five minutes of every class (except exam days and review-for-exam days) is spent discussing the assigned reading from *Einstein and Religion (1999)*. In addition, the students know that a small number of questions based on the material from this book are likely to appear on each of the four one-hour exams. Finally, they are encouraged to keep regular notes on the readings and discussions because toward the end of the course, they are required to submit a summary and response paper based on the book. In developing this paper, they are expected to anticipate a future discussion they might have with a professional colleague who possesses a worldview which is similar to that of Einstein. Along this vein, the students are asked to formulate a letter to Albert Einstein, as if he were still alive.

Einstein was known for answering letters he received from young people, even on issues of science and faith. It is hoped that this exercise will serve to prepare students for those opportunities that will inevitably arise when their professional colleagues can't help but ask them for the reason for the hope that they demonstrate as they joyfully and peacefully follow after Jesus Christ. Of course, the answer will mainly concern the importance of a relationship with Jesus, but scientists and engineers may also ask about how evidence from science might argue for or against such a commitment. This requires good stewardship of key information on the part of ORU graduates. As the Bible commands, believers should always be ready to give an answer (1 Peter 3:15). One of the educational objectives for the ORU engineering program is that graduates will demonstrate sensitivity to their Creator and be able to apply Christian principles of stewardship and discipline in their personal lives, being committed to professional and ethical standards of responsibility. This refers not only to proper stewardship of physical resources, but also personal resources such as time, energy, knowledge and wisdom. It is believed that the assignments and class time spent on science and faith issues are worth it, since the students are forming connections that they will be able to share in the future with people who may be in need of such information.

Results

This approach to faith and learning integration is based on a rubric which can be found in the appendix. This rubric was developed by Calvin Roso, Marcia Livingston, and Evalynne Lindberg of the ORU College of Education in January of 2013 (unpublished). The goal in this course is at least a consistent (level three) application of faith and learning integration practices as detailed by the rubric. The "Life of Educator" category of the rubric exhibits level four compliance in this case since the educator (primary author) has been researching, publishing, and implementing faith and learning integration for the last several years. He proposed and currently heads up the new ORU Center for Faith and Learning. He recently completed a Master of Arts in Biblical Literature at ORU. This education, combined with a PhD in Mechanical Engineering has equipped him to facilitate the integration of science and engineering with theology and biblical studies. In addition, as per the rubric, his personal belief system, life choices, and moral character reflect this commitment.

The "Scholarship" category of the rubric also exhibits level four compliance in this case. The educator has authored or co-authored 25 publications in the last 7 years in the area of science and faith integration, and especially the role of the field of engineering for such integration. He mentors students and faculty in this area, holding weekly research meetings to guide interested students. He also volunteers his time to educate laypeople on these topics by regularly teaching evening courses on science and faith at Believers Church in Tulsa, OK. As per the rubric, his publications identify foundational biblical principles and integrate those principles within science and engineering. They also discuss biblical criticism and apply biblical values to science and engineering. In addition, they help to defend a Christian worldview against those who would attempt to promote an incompatibility between science and Christianity. This work will be expanded over the next three years during the implementation of a major grant from the BioLogos Foundation to help the local Christian community reconcile their Christian faith with the well-established findings of mainstream science.

The "Instructional Planning" category of the rubric, as applied to the aforementioned physics course exhibits level three compliance in this case. Foundational biblical principles are identified and integrated into physics and engineering. Current Christian thinking in science and faith is discussed and critiqued. And, the integration of science and faith is related to professions in science and engineering, with particular regard for how ORU graduates might serve the needy in these areas, both materially and spiritually.

Regarding the "Instructional Delivery & Classroom Management" category of the rubric, a level three compliance is established. Daily class discussions promote a student-centered learning environment where a biblical foundation for physics and engineering is presented. The relevancy of Christianity and the Bible to learning physics and engineering is established. Biblical illustrations and examples are developed in comparing and contrasting issues in physics and engineering from a biblical perspective. Biblical morality and ethics in physics and engineering are promoted as important aspects of service to others in these fields.

The "Student Assessment" category of the rubric also exhibits level three compliance. The survey used as the assessment instrument is included in the appendix. It consists of six statements regarding the students' level of knowledge and understanding of the connections between physics and Christian faith. Students responded using a 1 to 5 Likert Scale, with 1 representing "strongly disagree" and 5 representing "strongly agree." Two additional questions allow students to provide written details on any of the six statements and offer suggestions for improving the integration of physics and faith. A retroactively administered pre-test using this instrument established initial levels of understanding. A post-test administered on the last day of class, using the same instrument, established final levels of understandings which had, on average, increased significantly in all six areas. The following table illustrates these increases in understanding:

Topic	Avg. Pre-test score	Avg. Post-test score	% Increase
How Christianity relates to physics	3.3	4.3	30
Relevancy of Christianity to physics	2.8	4.3	54
Use of biblical illustrations in physics	2.8	3.8	36
Present biblical truths to address issues	3.2	4.0	25
Biblical morality & ethics in physics	3.2	4.5	41
Serving others in physics	3.7	4.6	24

Correct (over 50 %) exam responses to questions related to *Einstein and Religion* reading assignments confirm the increases in understanding reported by the assessment instrument. Students' summary and response papers collected and graded near the end of the semester also demonstrated evidence of increased understanding. The vast majority of written responses on the assessment instrument were positive. However, two (out of a total of 31) respondents wrote that we used too much class time to discuss the integration of physics and faith. Two others wrote that they would want to take an entire class on this topic. Overall, the summary and response papers by the students were very good, especially the part where they addressed Einstein personally. Many of them picked up on the inconsistencies present in some of his theological statements. Here is one excerpt that was particularly insightful:

> If I had the chance to speak to Einstein or someone with similar worldviews, I would focus on speaking about Jesus. Einstein had great respect for Jesus, and recognized that He was an amazing figure in history. However, he was unable to come to the full revelation of God, as he does not submit to the Lordship of Jesus. Scripture in the Bible tells us of Jesus saying, "I am the way and the truth and the life. No one comes to the Father except through me" (NIV John 14:6)…In conclusion, I would help Einstein come to a better understanding of Christ so that he can accept Christ's Lordship over his life.

Conclusions

Guided by the existing research in faith and learning integration, a module was developed and implemented to assist undergraduate students in exploring connections between physics and Christian faith. The core of the module consisted of auxiliary reading assignments from *Einstein and Religion*, with regular in-class discussions, exam questions, and a summary and response paper. A rubric for faith and learning integration was applied to assess the effectiveness of this module. Results suggest that a modest level of faith and learning integration has been achieved in a first-year physics course for science and engineering students.

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Appendix

FLI Assessment Rubric

	Level One Orientation	Level Two Inconsistent	Level Three Consistent	Level Four Refinement
Life of the educator	Interest in FLI is evident in initial application to one life area.	Growth in FLI is evident in two or more life areas.	Commitment to FLI is evident in consistency in three or more of the following life areas: personal belief system, life choices, moral character, knowledge about biblical principles and active service to others in the profession and the community.	Passion for FLI is evident in reflections and accountability within four or more life areas.
Scholarship	Scholarly articles and presentations consider one method to promote FLI.	Scholarly articles and presentations attempt to promote FLI using one or two methods.	Scholarship is anchored in FLI. Articles and presentations consistently promote FLI by using three or more of the following methods: • identifying foundational biblical principles and integrating those principles within scholarship • modeling biblical criticism within the academics • applying biblical values to related professions	Scholarship consistently promotes FLI by using four or more methods. The educator submits, publishes, and/or presents FLI scholarly research on a bi-yearly basis and/or mentors others in FLI.
Instructional planning	Instructional planning considers one method to promote FLI.	Instructional planning attempts to promote FLI using one or two methods.	Instructional planning promotes FLI by integrating research-based methods of FLI as evidenced in course goals and objectives using three or more of the following: • identifying foundational biblical principles and integrating those principles within the academic area • critiquing Christian research regarding the subject area • connecting FLI to related professions • connecting FLI to serving others	Instructional planning includes an annual reflection of FLI and records evidence of revisions made to improve the effectiveness of FLI.
Instructional delivery & classroom management	Instruction considers one method to promote FLI.	Instruction attempts to promote FLI using one or two methods.	Through a student-centered learning environment, instruction presents the biblical foundation of the academic subject area and three or more of the methods: • arguing the relevancy of Christianity and the Bible to learning • using biblical illustrations and examples • comparing or contrasting academic issues from a biblical perspective • presenting biblical truths both implicitly and explicitly • using biblical principles to address current issues within academic subject • promoting biblical morality or ethics in the related profession • promoting service to others through the related profession	Instructional delivery includes multiple (four or more) opportunities for students to practice FLI within the content area through group projects, discussion, research, and/or reflective essays.
Student Assessment	Assessments consider one area of FLI.	Assessments include two or more areas of FLI.	Course pre- and post-assessments identify an improvement in students' knowledge and understanding of how biblical worldview, biblical morality, and/or the promotion of service to others apply to the subject area and/or related profession.	Assessments require students to identify an area of need that FLI can meet within their profession.

Rubric developed by Calvin Roso, Marcia Livingston, and Evalynne Lindberg (January 2013, unpublished).

Assessment of Dr. Halsmer's PHY 111 Class (Integration of Faith and Physics)
Oral Roberts University, April 2013

Please circle the number that best describes your reaction to each statement.

1. I have knowledge and understanding of how Christianity & a biblical worldview relates to physics.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

2. I understand the relevancy of Christianity and the Bible to learning physics, and vice versa.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

3. I can use biblical illustrations and examples to shed light on academic issues in physics.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

4. I can present biblical truths and principles to address current issues in physics.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

5. I understand how biblical morality and ethics are important in the study and practice of physics.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

6. I understand how knowledge of physics is important for serving others, both materially & spiritually.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

Please provide further details on any of the above statements:

What suggestions would you give for improving faith and physics integration?