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THE SUSTAINABILITY AS STEWARDSHIP FRAMEWORK: A BIBLICAL MODEL FOR ADDRESSING ENVIRONMENTAL AND SOCIAL ISSUES IN ENGINEERING EDUCATION

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Introduction

The Engineering for One Planet (EOP) Framework [1] was developed from 2017 to 2022 by the Lemelson Foundation, VentureWell, Alula Consulting and hundreds of individual contributors, and consists of 92 “essential sustainability-focused learning outcomes.” The framework has a stated goal to “Transform engineering education to ensure all engineers are equipped with the skills, knowledge, mindsets, and understanding to protect and improve our planet and our lives” [1]. The framework proposes that truly sustainable designs require consideration of the interconnectedness of (1) systems thinking, (2) knowledge and understanding, and (3) skills, experiences, and behaviors across a variety of different topical areas, as shown in Figure 1. The framework is supported by ASEE and has been growing in popularity recently [2].



Figure 1. The Engineering for One Planet Framework [1]

As sustainability and other social responsibility topics rise in importance in the eyes of ABET and many engineering employers, so does the importance of developing systematic, holistic means to

better emphasize sustainable design within an engineering curriculum. The EOP framework contains a large amount of helpful information related to the topics that are important to a quality sustainability education. However, the number of outcomes it suggests incorporating into a curriculum are far too great for integration into most existing curricula. The framework is also based on a different and, at times, conflicting worldview to a Biblical worldview. After considering how to better incorporate sustainability education into the engineering curricula at the authors' institution, a significant modification of the EOP framework was developed around a simpler structure and a Biblical basis.

Background on the Development of the Sustainability as Stewardship Framework

Sustainable design has become an increasingly more valued part of an engineering education [2, 3, 4, 5], particularly in the field of civil engineering [6]. However, sustainability education has often either been relegated to only being discussed in specific, targeted courses or haphazardly “tacked-on” as an extra topic in a handful of otherwise standard courses in a curriculum. Engineering textbooks often support these approaches, either focusing exclusively on sustainability topics or only including a small chapter toward the back of the textbook in later editions on sustainable design. With either of these approaches, it is difficult to set and achieve meaningful outcomes related to how students may integrate sustainable principles into technical design within their respective fields.

The EOP framework encourages educators to consider a holistic approach constituting many different topics to provide a quality sustainable design education. For this education to be most effective, these topics should be integrated in a coordinated manner throughout the entire curriculum. This multi-topic, full curriculum integration of sustainability education is clearly an effective innovation of the EOP framework. However, the 92 outcomes proposed in the framework (46 “core” and 46 “advanced”) exceed any reasonable expectations for adapting the framework into an existing curriculum.

The civil engineering program at Cedarville University set a target to improve its sustainability curriculum and considered adapting the EOP framework. Rather than choosing only a few out of the many outcomes the EOP framework offers, however, the decision was made to instead redevelop the idea of a sustainability framework around a more achievable set of intended outcomes. This led to the initial conception of the Sustainability as Stewardship (SaS) framework.

Other than some characteristics of the structure of the EOP framework and several of the specific topics, one additional attribute that the SaS framework redevelopment sought to maintain throughout the redevelopment process was the adaptability of the framework to different discipline areas. While the initial development of the complete SaS framework centered on civil engineering (the authors' program), the framework structure and many of the curriculum modules were created with the intent that they could be implemented into any engineering or technical design discipline.

While the EOP framework claims alignment with ABET requirements [1], the relationship between the EOP framework outcomes and ABET outcomes often appear weak or unclear. The development of the SaS framework offered the opportunity to not only consider how to better educate students about sustainability issues, but also to develop a series of curriculum pieces and assignments that will conceivably provide long-term alignment with ABET accreditation requirements, most specifically the societal, environmental, economic, and global design contexts. These contexts show up in ABET student outcomes 2 and 4, which specify that students should gain “an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors” and “an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts,” respectively [7].

Perhaps the most significant change implemented in the creation of the SaS framework was the establishment of the motivation behind sustainable design to be based on a Christian worldview. While most of the EOP framework does not conflict with a Christian worldview, it is still based on humanistic motivations of social responsibility and systems thinking; essentially, because engineers have the ability to affect change in their societies, the framework proposes that they should be thoughtful about how their designs can create either positive or negative impacts. Without any sort of ultimate standard by which to judge those impacts, however, the entire motivation for sustainable design rests on some relatively simplistic ethics that may be difficult to interpret and apply correctly in complex scenarios. For example, in balancing the requirements for a particular job, should environmental, social, or financial considerations ultimately drive the decisions that are made, if resources are not sufficient for all to be equally satisfied? The EOP framework introduces students to some of these challenges but is ultimately incapable of providing the moral structure necessary to attach appropriate meaning to sustainable practices.

Christians have the advantage of an ultimate standard against which potential positive or negative results of actions may be judged. By recasting the concept of sustainable design as a faithful act of Christian stewardship, students can see how their work as a designer is not necessarily neutral, but instead either aligned with or conflicting with God’s Word. With this in mind, the SaS framework was developed around the core principle that producing sustainable engineering and technology solutions is a faithful application of the concept of stewarding well the resources God has given us as human beings and designers. Bringing this concept of stewardship into the sustainable design conversation helps students see the greater meaning behind their engineering design work and invites the standard of Biblical truth to be used as the ultimate metric for judging “good” design decisions.

The Sustainability as Stewardship Framework

The SaS framework (Figure 2) consists of eight topic areas, each consisting of at least one learning module that would be equivalent to a single class lesson plan. To develop the concept of practicing sustainable design as a form of stewardship, the SaS framework is built around the core and introductory module 1 Sustainability as Stewardship, which is introduced to students early in their education.

Sustainable design is dependent on consideration of how to best make use of economic, environmental, and social resources to enhance the safety, welfare, and quality of life of all stakeholders [6]. The SaS framework includes modules on how design decisions are interrelated with environmental, economic, and societal contexts (modules 2 – 4) as well as their impacts on all of society, defined here as the global context (module 5). All of the curriculum modules 1 – 5 are intended to be generally applicable to students from any engineering, computer science, or other technology design majors.

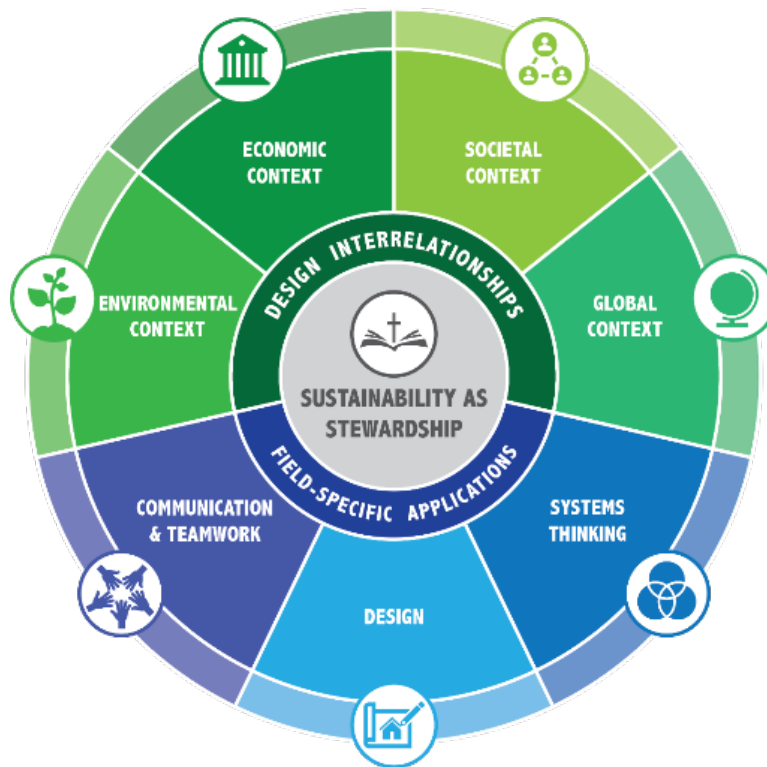


Figure 2. The Sustainability as Stewardship Framework

In addition to the general understanding of sustainability developed through curriculum modules 1 – 5, it is also critical that students learn to apply these concepts within their intended fields. Students are introduced to systems thinking (*implications of design*), design (*applications of design*), and communication & teamwork (*implementation of design*) that are specific and relevant to their field of study in curriculum modules 6 – 8. While the initial implementation of the SaS framework included development of a total of eight modules related to the field-specific

application topics within the field of civil engineering, other programs may adopt the SaS framework by developing their own field-specific modules related to these topics based on the general learning outcomes.

The modules of the SaS framework are intended to be taught as single-lesson courses scattered throughout an entire curriculum. As an example, the curriculum implementation of the framework in the civil engineering program at Cedarville University is shown in Appendix A. The full list of modules and outcomes is also included in Appendix A.

The Biblical Basis for Sustainability as Stewardship

A longstanding challenge accompanies teaching sustainability topics in a Christian context. This conflict most distinctly came to light with Lynn White, Jr.'s publication of "The Historical Roots of our Ecological Crisis" in 1967, within which he presented an argument that protestant sects of Christianity overemphasize an anthropocentric value system to the detriment of the natural environment [8]. While many responses to and reevaluations of White's hypothesis have been published over the years since [9, 10, 11, 12, 13, 14], at least a few of his observations have been shown to possess merit. Survey results have shown that beliefs in Biblical literalism (called fundamentalism by some authors), dispensationalist eschatology, and conservative political ideologies are each generally associated with a more negative view of environmental topics, although it is feasible that the majority of that perspective stems from the political rather than theological beliefs [2]. Regardless of the specific source of the environmental skepticism, however, it is reasonable to assume that many students at a conservative Christian college may enter the engineering classroom with a predisposition against sustainability topics that are advocating for environmental care. General predispositions against related topics of engineering for social contexts (e.g. diversity, equity, and inclusion, or DEI) are likely even more significant in the Christian engineering classroom.

The combination of both complex issues to be discussed and a charged learning environment does not preclude good education from happening, although it does necessitate a careful, Biblical approach. The development of the SaS framework around the core Biblical principle of stewardship creates the opportunity to address not only the technical aspects of sustainable design, but also some more difficult applications related to environmental and social issues. For this approach to be effective, students are first be introduced to the theological background for sustainability as stewardship, which is developed through a 10-step progression (see Appendix B for a listing of references supporting the first nine points).

1. God created, sustains, and affirms all creation, both human and non-human, as belonging to Him.
2. God gave human beings the responsibility of stewardship.
3. God desires for people to care for the non-human creation.
4. God desires for people to care for other humans.
5. Sin leads to all humans having a broken relationship with God and damaged and exploitative relationships with each other and the rest of creation.

6. God values justice for both the guilty and innocent but has mercy for those who repent.
7. God's plan for the future culminates in a restoration of creation, both human and non-human, through the life, death, and resurrection of Jesus Christ.
8. As followers of Jesus Christ, we are not our own, but are instead members of His body and servants of God.
9. Our work matters to God, should reflect God's values, and should align with God's purposes.
10. Designing for sustainability, with its conscientious use of resources and consideration of environmental, economic, societal, and global contexts, is a helpful framework for approaching design work in a manner consistent with faithful stewardship and obedience, reflecting God's love for humans and the rest of His creation, upholding His values of justice and mercy, and aligning with his plan for future restoration.

The first module of the SaS framework introduces students to the concept of sustainability and then develops this Biblical basis for Christian engineers who view their work as stewardship to support it. This core concept of Biblically supported stewardship also provides a reliable foundation for all of the other modules that make up the framework. A closer look at two of the most challenging topics in the framework, the environmental design context and design considerations related to the social issues of DEI, can provide brief examples of some of the framework development and applications.

The Environmental Context Module

The environmental context module of the SaS framework presented a Biblical foundation for environmental stewardship by drawing a relationship between human flourishing, God's care for creation, and humanity's responsibility as stewards of creation. This module intended to help students to begin thinking about how environmental care is an aspect of Biblical stewardship and open a discussion about how to have productive conversations with others who have conflicting beliefs in this matter. The approach to incorporating environmental stewardship into the SaS framework therefore focuses on:

1. Identifying where principles of environmental stewardship fit within a Biblical worldview (including recognition of conflicting worldviews)
2. Stirring students' interest in environmental topics

This module is introduced as a persuasive argument outlining the “environmental steward” position in relation to a Biblical worldview. A brief historical account is discussed, including longstanding conservation practices, the development of modern environmentalism, and the conservative Christian response to that movement. For much of human history, most communities lived in cooperation with the land, practicing agrarian living by raising livestock, reaping a harvest from the land, and trading their wares in community. In this way, human flourishing has been closely tied to conservation practices. This terminology shifted in the last century from conservationism to environmentalism, and with it came ideological changes as well. Some of the most significant changes can be traced back to the 1960s environmentalism movement in the

western world, which was bolstered with several ongoing social and political movements, including the establishment of the US EPA. Accompanying this shift, some proponents encouraged movement toward socialistic economy and policies, while other extreme advocates even promoted violence against humans for the sake of restoring the environment to natural, idyllic bliss [15].

Because of this change in language to environmentalism, as well as the provocative association with more liberal politics and violent social action, many evangelical churches have expressed significant reservations, even rejection, toward any environmentalist topics. This critical view certainly has merit, as Christians affirm the sanctity of human life above that of the environment, as image bearers of God. While this conflict against extremist viewpoints is valid, the Bible records that God's first instructions to mankind are to care for the earth. God clearly tells Adam and Eve to "Be fruitful and multiply and fill the earth and subdue it and have dominion over the fish of the sea and over the birds of the heavens and over every living thing that moves on the earth" (Genesis 1:28). Humanity is tasked with stewarding the earth because God commanded that we care for His gift to us [16].

Some sects of evangelical Christianity also align with a dispensationalist theology positing that the earth is temporary and will be destroyed with literal fire, to be recreated after Christ's second coming (ref. 2 Peter 3:10-13, Revelation 21:1-5). Adherents do not see the earth as a permanent feature of creation and advocate allowing the earth to fall into disrepair in favor of pursuing other Christian tenets more fervently. Those holding this theological position tend to dismiss actions promoting environmental sustainability, which has also led to some Christians opposing environmentalist issues comprehensively. However, this interpretation of Scripture is arguably inconsistent with other passages that show the Lord's care for all of His creation and the promise that all creation will be restored or renewed (refer to point 7 in Appendix B for Biblical support).

The digital age has ushered in a cultural shift, giving an opportunity to spotlight significant and sometimes far-away environmental issues. The connectedness of the internet, over which individuals can share images and view global news instantly, has made complex topics accessible to laymen. By extension, this access has created a sympathetic edge to the environmental movement and sustainability topics with younger Christians, especially university students, who have grown up with reusable water bottles and awareness of global water scarcity. Today, some of the evangelical antipathy concerning pressing environmental topics has been replaced with open dialogue and advocacy for "creation care," a phrase akin to environmental stewardship that values both human life and having careful dominion of the earth.

After introducing some of the challenging background between Christianity and environmental issues, the module lesson continues by reintroducing five of the ten SaS tenets of Biblical stewardship and a response of the "environmental steward" is presented with each of the five, including specific language relating to designing for the environmental context. To give a well-rounded view of Christian and secular thought on any of these ideas and to stimulate discussion, a few dissenting beliefs are presented alongside the proposed "environmental steward" perspective. Students are given multiple opportunities to think, respond, or counter ideas presented. For

example, the principle “God desires for people to care for the non-human creation” has a corresponding environmental steward response that “Christians are dedicated to preserving, sustaining, and dealing mercifully with non-human creation – land, oceans, wild animals, livestock, natural resources.” A dissenting belief identified here is that “A Christian’s sole focus should be on evangelism instead of caring for non-human creation.” After this presentation and discussion, students are reminded of the definition of stewardship - the responsibility Christians have to actively manage and make use of the resources God has entrusted to them in a manner consistent with God’s commands and character. The module is followed up with a writing assignment to which students respond to at least two of the biblical framework statements by answering the following questions:

- Are the “environmental steward” responses to the biblical truth accurate or comprehensive? If not, describe what you believe is a more accurate approach.
- Do your personal beliefs align with the environmental steward responses? Justify why you believe this way and how your actions align with your beliefs.
- Identify at least one area that you felt challenged in, and what steps you might take to learn more.

Introducing this topic with language of environmental stewardship was intended to establish strong, empathetic character in our students. By incorporating a Biblical worldview, students could see a way to approach these topics with faithful obedience, Christlike humility, and empathy to others with different views. By extension, putting these ideas into words may allow them to have meaningful conversations with people who disagree about these topics. This module discussion and follow-up response assignment were also successful in motivating students to consider the environmental impacts of their own decisions, an originally unintended benefit of discussing these topics.

Diversity, Equity, and Inclusion Modules

The SaS framework provides two natural opportunities to discuss how Christian engineers should approach topics of DEI: one related to the societal design context from the perspective that these principles are relevant to producing socially sustainable designs, and one related to communication and teamwork from the perspective that principles of DEI influence how we work alongside others to complete design projects. The sustainability of a design, based on a broad understanding of sustainability [6], requires both the design process and the end product to be accepted by general society.

The DEI movement and conservative Christianity have a dissonance between them that is a more recent development than the conflict between environmentalism and Christianity, but likely also more pronounced. Some of this is clearly merited, as there are many applications and corollaries of DEI that are based on worldviews conflicting with a Christian worldview. But, as with environmental issues, some of this conflict may also stem more from commonly associated political ideologies than Biblical theology. The approach to incorporating DEI into the SaS framework therefore focuses on:

1. Identifying where principles of DEI fit within a Biblical worldview (including recognition of conflicting worldviews)
2. Emphasizing those values that overlap between a Biblical worldview and professional engagement with DEI

In both of the learning modules related to DEI in the SaS framework, diversity, equity, and inclusion are introduced to students using ABET's definitions of the terms [17]. This allows for open discussion in the classroom, but also documentation of curricular coverage that clearly aligns with accreditation expectations. To broadly address where these principles fit within a Biblical worldview, students are introduced to C.S. Lewis's concept from *The Screwtape Letters* of how Christians can be compromised by being kept in a state of mind he calls "Christianity And" [18]. In this mindset, Christians become focused not solely on Biblical truth (what Lewis's character Screwtape calls the "Same Old Thing"), but through the attraction of "change" they attempt to marry Biblical truth to new ideas, elevating the new ideas to the same level as Biblical truth. Christians must live their lives within the culture of the world. There are many injustices they could work to right and ideologies they could embrace that are, in and of themselves, good things. However, when those good things are made to be ultimate things, when an attempt is made to elevate a second thing into a first thing, or when a core identity is adopted of believing in "Christianity And Something," that is a sign that Christians have fallen into idolatry and raised something that is of the world to a level that should be inhabited by God, His ways, and His principles alone. Without this conceptual foundation, the pitfall exists to elevate DEI values to a place where they are equated with God's values, ultimately compromising the ability to achieve truly just outcomes. This orientation of DEI principles helps establish that, despite whatever overlaps might exist, cultural DEI initiatives are still secondary objectives and subordinate to the Christian's commitment to serve the Lord.

With the established subordination of DEI principles to Biblical truth, the modules then advance the discussion into looking at how God's Word encourages believers to promote principles of diversity, equity, and inclusion that are rightly aligned with His justice, using scripture and comments from a few helpful Christian authors [19, 20, 21]. In one module, students are also introduced to how professional practice can benefit from appropriate application of DEI principles. In another module, students are introduced to a number of questions and suggestions related to how DEI might intersect their potential professional future, including:

- Will I have a hard time getting hired or promoted even though I'm well qualified if I don't possess any desirable diversity characteristics?
- If some people are given an advantage while others aren't, doesn't that violate the whole idea of equality?
- How can I be faithful to my Biblical beliefs while interacting with someone who identifies themselves in a particular way or lives a lifestyle that I believe to be morally wrong?
- If my company holds values that I believe are contradictory to my Biblical beliefs, what should I do?

Addressing these and other questions students may have about how culture may affect their professional futures can help equip students with (1) a Biblical lens through which to examine DEI issues appropriately, (2) a professional appreciation for ways that appropriate application of DEI practices can improve their workplace culture and outcomes, and (3) a Godly motivation to serve as agents of reconciliation within their culture and workplaces.

Preliminary Feedback

As the framework is still in its first year of implementation, the only student feedback available at this time is through anecdotal and informal assessment. On a broad basis, civil engineering students have responded enthusiastically about the introduction of the SaS framework and the associated topics, particularly the framing of environmental care as an act of stewardship. Several freshman students identified the introductory Sustainability as Stewardship module as their favorite topic from a seminar-style course. Junior students responded to the environmental context module assignment (mentioned previously) with positive statements such as:

- “It’s important to remember how science can be used to better predict long-term environmental effects, but also (and more importantly) how wisdom from the Bible can be applied to the handling of such policies that affect many different issues that we face today as a society.”
- “I appreciated that the dissenting beliefs were presented which help us find the boundaries of what these Biblical truths actually mean for Christ-followers. My beliefs do align with the environmental steward responses given as it is the way that I think about creation. I think something that I feel challenged in was how I’m actually living out what I believe. I realized that while I don’t seek to destroy the environment, I’m not seeking to better it, at least consciously.”
- “I felt challenged by this Biblical truth since I personally feel more inclined to worry about my own comfort and ease instead of the rest of God’s creation... This assignment has given me a certain level of conviction when it comes to my impact on creation while also giving me confidence in my ability to tell dissenters my point of view.”
- “I really enjoy these kinds of assignments. It allows me to look at my studies and future career through a bigger lens. I thank you and the other Civil Faculty for being intentional about bringing these things up in our studies.”

A few criticisms to the environmental context module included one student’s belief that human life should be more strongly emphasized as of primary importance over any environmental concerns, and another student’s belief that active engagement in care for the environment should be more strongly emphasized.

One of the DEI-related modules was implemented unattached to the rest of the SaS framework for students across the broader school of engineering. Initial responses from those students to the topics presented in that lesson were predictably mixed. While some expressed appreciation for the learning modules and a belief that their education should include more discussions along these lines, others viewed the discussion of DEI topics as either irrelevant or inappropriate. According

to one student's written response, "I see DEI stuff as, what I would call, fake Christianity. This is how the world wants God without the responsibility. We should instead talk about Christian values, not godless heathen values." Despite the effort to establish a Biblical foundation for the discussion, some students are still clearly resistant to the conversation. However, implementing the full curricular integration of the SaS framework in the future will likely do a better job of helping students recognize the Biblical foundation and the stewardship mentality woven throughout the framework.

Conclusions and Further Work

The SaS framework was developed as a tool for teaching sustainability and related topics from a Biblical foundation in an engineering program. As a significant modification of the EOP framework, the SaS framework aimed to reduce complexity, more clearly relate to ABET outcomes, and better align with a Biblical worldview. The SaS framework retains some positive characteristics from the EOP framework, such as the holistic approach to sustainable design and the adaptability to different disciplines. The civil engineering version of the framework integrates thirteen lesson modules across an entire civil engineering curriculum, offering students an opportunity to gradually develop a sustainable design mindset and consider multiple examples of how they could incorporate sustainability principles in their future careers.

In addition to providing a comprehensive structure for sustainability education, this framework offers the opportunity to engage students with some challenging topics related to the environmental and social aspects of design work. As a general approach, modules in the framework start by identifying the Biblical foundation for these topics then aim to help students identify related professional applications and behaviors. Initial responses from students are mostly encouraging, but also highlight the complexity associated with these topics that stems from the students' varying backgrounds.

In the future, the authors plan to continue to implement the SaS framework across their civil engineering program, making curricular adjustments as needed based on experiences and feedback. As ABET requirements related to sustainability and DEI topics change, the approaches proposed in the learning modules may also be adapted to better target accreditation requirements. The authors also welcome the idea of other programs at their own institution as well as programs at other institutions piloting new adaptations of the framework and providing feedback on the results of its implementation.

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Framework for review or implementation, including editable versions of all lesson plan materials, please contact one of the authors.

References

- [1] Engineering for One Planet, "The Engineering for One Planet Framework: Essential Sustainability-focused Learning Outcomes for Engineering Education," The Lemelson Foundation, 2022.
- [2] D. B. Dittenber and M. L. Booth, "The Sustainability as Stewardship Framework: A Revision of the Engineering for One Planet Framework for an Existing Civil Engineering Program at a Christian Institution," in *2024 ASEE Annual Conference*, Portland, OR, 2024.
- [3] F. S. Crofton, "Educating for Sustainability: Opportunities in Undergraduate Engineering," *Journal of Cleaner Production*, pp. 397-405, 2000.
- [4] J. A. Mesa, I. E. Esparragoza and H. E. Maury, "Sustainability in Engineering Education: A Literature Review of Case Studies and Projects," in *15th LACCEI International Multi-Conference for Engineering, Education, and Technology*, Boca Raton, 2017.
- [5] C. F. Murphy, D. Allen, B. Allenby, J. Crittenden, C. I. Davidson, C. Hendrickson and H. S. Matthews, "Sustainability in Engineering Education and Research at U.S. Universities," *Environmental Science & Technology*, pp. 5558-5564, 2009.
- [6] American Society of Civil Engineers, "Policy statement 418 - The role of the civil engineer in sustainable development," 6 June 2023. [Online]. Available: <https://www.asce.org/advocacy/policy-statements/ps418---the-role-of-the-civil-engineer-in-sustainable-development>. [Accessed 3 January 2024].
- [7] ABET Engineering Accreditation Commission, "Criteria for Accrediting Engineering Programs," ABET, Baltimore, 2023.
- [8] L. White, Jr., "The Historical Roots of our Ecological Crisis," *Science*, vol. 155, no. 3767, pp. 1203-1207, 10 March 1967.
- [9] H. H. Boyd, "Christianity and the Environment in the American Public," *Journal for the Scientific Study of Religion*, vol. 38, no. 1, pp. 36-44, March 1999.
- [10] D. L. Eckberg and T. J. Blocker, "Christianity, Environmentalism, and the Theoretical Problem of Fundamentalism," *Journal for the Scientific Study of Religion*, vol. 35, no. 4, pp. 343-355, December 1996.
- [11] A. Greeley, "Religion and Attitudes toward the Environment," *Journal for the Scientific Study of Religion*, vol. 32, no. 1, pp. 19-28, March 1993.
- [12] J. L. Guth, J. C. Green, L. A. Kellstedt and C. E. Smidt, "Faith and the Environment: Religious Beliefs and Attitudes on Environmental Policy," *American Journal of Political Science*, vol. 39, no. 2, pp. 364-382, May 1995.
- [13] W. Jenkins, "After Lynn White: Religious Ethics and Environmental Problems," *The Journal of Religious Ethics*, vol. 37, no. 2, pp. 283-309, June 2009.

- [14] F. A. Schaeffer, *Pollution and the Death of Man: The Christian View of Ecology*, Wheaton, IL: Tyndale House Publishers, 1970.
- [15] R. Goodland, "The Concept of Environmental Sustainability," *Annual Review of Ecology and Systematics*, vol. 26, pp. 1-24, 1995.
- [16] S. L. Richter, *Stewards of Eden*, Downers Grove, IL: InterVarsity Press, 2020, pp. 67-90.
- [17] ABET, "Diversity, Equity & Inclusion," ABET, 2023. [Online]. Available: <https://www.abet.org/about-abet/diversity-equity-and-inclusion/>. [Accessed 31 May 2023].
- [18] C. S. Lewis, *The Complete C.S. Lewis Signature Classics*, San Francisco: HarperCollins, 2002.
- [19] R. McLaughlin, *Confronting Christianity: 12 Hard Questions for the World's Largest Religion*, Wheaton: Crossway, 2019.
- [20] R. McLaughlin, *The Secular Creed: Engaging Five Contemporary Claims*, Austin, TX: The Gospel Coalition, 2021.
- [21] T. J. Williams, *Confronting Injustice without Compromising Truth: 12 Questions Christians Should Ask About Social Justice*, Grand Rapids, MI: Zondervan Academic, 2020.

Appendix A: Topic and Module Learning Outcomes and Example Implementation Plan

Topic/Module 1: Sustainability as Stewardship

Students will be able to identify their responsibility to be faithful stewards of the resources God has given them and recognize their associated role as design professionals to produce good and sustainable solutions.

Topic/Module 2: Environmental Context

Students will be able to identify the Biblical framework environmental stewardship - the relationship between human thriving, God's care for creation and humanity's responsibility as stewards of creation - and the practical implications of such beliefs.

Topic/Module 3: Economic Context

Students will be able to examine financial risks and opportunities and weigh near- and long-term costs and values related to design solutions.

Topic/Module 4: Societal Context

Students will be able to identify and make ethical decisions regarding the social impacts of their professional behaviors and designs, including concepts such as diversity, equity, inclusion, and accessibility, as well as public health, safety, and welfare.

Topic/Module 5: Global Context

Students will be able to identify how globalization has led to the UN Sustainable Development Goals and recognize potential intersections between these goals and their professional aspirations.

Topic 6: Systems Thinking

Students will be able to explain the dynamic interrelationships of environmental, economic, social and/or global contexts, and study real-world problems and their solutions as they relate to applications within their field.

Module 6A (Civil): Introduction to Systems Thinking

Students will be able to identify renewable and nonrenewable sources of energy, understand how life cycle assessments (LCAs) work, and participate in a guided LCA of coal power.

Module 6B (Civil): Climate Change and Stormwater Management

Students will be able to identify major causes of climate change (natural and anthropogenic) and the effects of climate change on water quantity, and discuss long-term effects of flooding.

Module 6C (Civil): Tradeoffs in Formalizing Policy

Students will be able to identify the various approaches to pollution control laws and decipher complex information to make decisions about policy-related tradeoffs.

Topic 7: Design

Students will be able to evaluate design options within their field, considering the four sustainable design contexts and selecting solutions that will maximize positive and minimize negative impacts.

Module 7A (Civil): Introduction to Sustainable Design and Construction

Students will be able to identify key initiatives in the history of sustainable construction in the US and recognize applications for a few basic concepts of green building design and construction.

Module 7B (Civil): Sustainable Materials and Green Building Design

Students will be able to evaluate material alternatives based on their sustainability characteristics and identify key features of the USGBC LEED building assessment standard.

Module 7C (Civil): Culture and Community Needs Assessment

Students will be able to assemble an effective plan for collecting relevant cultural information from a community in order to define design specifications for an international development project.

Topic 8: Communication & Teamwork

Students will be able to effectively communicate with different audiences, demonstrate characteristics of good leadership, and incorporate Biblically consistent principles of diversity, equity, and inclusion into their professional interactions with clients and team members.

Module 8A (Civil): Teamwork in Civil Engineering Education

Students will be able to self-identify their own team-related strengths and weaknesses and work effectively on a team, creating a collaborative and inclusive environment where individual contributions are welcomed and appreciated.

Module 8B (Civil): Diversity, Equity, and Inclusion in the Civil Engineering Workplace

Students will be able to demonstrate positive behaviors related to principles of diversity, equity, and inclusion in their professional interactions and incorporate related concepts into their engineering designs.

Table 1 – Example Implementation of the SaS Framework

Topic	Module	Discipline	Course	Semester
Sustainability as Stewardship	1 Sustainability as Stewardship	General	EGGN-1110 The Engineering Profession	1
Environmental Context	2 Environmental Stewardship	General	EGCE-3610 Environmental Engineering	5
Economic Context	3 Risk and Opportunity: Environmental, Social, and Governance	General	EGCE-3910 Civil Engineering Management	4
Societal Context	4 Social Impacts of Engineering Decision-Making	General	EGGN-3110 Professional Ethics	6
Global Context	5 Globalization: United Nations Sustainable Development Goals	General	EGCE-1920 Introduction to Civil Engineering	2
Systems Thinking	6A Introduction to Systems Thinking	CE-Specific	EGCE-3610 Environmental Engineering	5
	6B Climate Change and Stormwater Management	CE-Specific	EGCE-4220 Hydrology	8
	6C Tradeoffs in Formalizing Policy	CE-Specific	EGCE-4620 Environmental Management and Policy Development	8
Design	7A Introduction to Sustainable Design and Construction	CE-Specific	EGCE-3410 Construction Engineering	5
	7B Sustainable Materials and Green Building Design	CE-Specific	EGCE-4520 Design of Wood Structures	8
	7C Culture and Community Needs Assessment	CE-Specific	EGCE-4920 Infrastructure for Developing Contexts	8
Communication and Teamwork	8A Teamwork in Civil Engineering Education	CE-Specific	EGCE-1920 Introduction to Civil Engineering	2
	8B Diversity, Equity, and Inclusion in the Civil Engineering Workplace	CE-Specific	EGCE-4910 Civil Engineering Practice	8

Appendix B: Extended Biblical Basis for Sustainability as Stewardship

1. God created, sustains, and affirms all creation, both human and non-human, as belonging to Him.
(Genesis 1:31, 9:9-10; Job 38-39; Psalm 24:1-2, 104:1-35, 139:13-14; Isaiah 40:21-26; Matthew 6:26-30, 10:29; John 3:16-17; Acts 17:26-28)
2. God gave human beings the responsibility of stewardship.
(Genesis 1:26-28, 2:15,19-20; Matthew 25:21; 1 Corinthians 4:1-2)
3. God desires for people to care for the non-human creation.
(Leviticus 25:1-7; Deuteronomy 20:19-20, 22:6-7; Job 12:7-10; Psalm 8:3-9, 115:16; Proverbs 12:10; 1 Corinthians 10:26)
4. God desires for people to care for other humans.
(Leviticus 19:9-10,33-34; Deuteronomy 22:8; Psalm 82:2-4; Habakkuk 2:9-11; Zechariah 7:9-10; Matthew 22:36-40, 25:35-40; Galatians 6:2-10; Philippians 2:3-4; James 1:27, 2:1-26; Hebrews 13:1-3)
5. Sin leads to all humans having a broken relationship with God and damaged and exploitative relationships with each other and the rest of creation.
(Genesis 3:17-18; Isaiah 24:4-6, 59:1-2; Romans 3:23, 5:12, 8:22-23; James 4:17; 1 John 2:11)
6. God values justice for both the guilty and innocent but has mercy for those who repent.
(Deuteronomy 32:35-36; Psalm 146:5-9; Ecclesiastes 3:17; Isaiah 1:16-17; Jeremiah 22:3; Micah 6:8; Matthew 23:23; Luke 6:36; Hebrews 10:30)
7. God's plan for the future culminates in a restoration of creation, both human and non-human, through the life, death, and resurrection of Jesus Christ.
(Psalm 96:10-13; Isaiah 65:17-25; Matthew 28:19-20; John 3:16-17; Acts 3:19-21; Romans 8:18-21; Colossians 1:19-20; 2 Peter 3:10-14; Revelation 5:13, 7:9-10; 21:1-5)
8. As followers of Jesus Christ, we are not our own, but are instead members of His body and servants of God.
(John 12:26; 1 Corinthians 6:19-20, 12:14-27; 2 Corinthians 5:17-20; Galatians 1:10; Colossians 3:23-24)
9. Our work matters to God, should reflect God's values, and should align with God's purposes.
(Deuteronomy 8:17-18; Luke 12:47-48; 1 Corinthians 3:12-13; Ephesians 2:10)
10. Designing for sustainability, with its conscientious use of resources and consideration of environmental, economic, societal, and global contexts, is a helpful framework for approaching design work in a manner consistent with faithful stewardship and obedience, reflecting God's love for humans and the rest of His creation, upholding His values of justice and mercy, and aligning with his plan for future restoration.