Article

Not peer-reviewed version

Inspiring Sustainability in Undergraduate Engineering Programs

Tina Griesinger *, Kenneth Reid, David Knight, Andrew Katz, John Somers

Posted Date: 8 April 2024

doi: 10.20944/preprints202404.0505.v1

Keywords: environmental sustainability; engineering education; learning experiences; career interests

Article

Inspiring Sustainability in Undergraduate Engineering Programs

Tina Griesinger [1,*], Kenneth Reid [2], David Knight [3], Andrew Katz [1] and John Somers [4]

[1] Virginia Polytechnic and State University; tgriesinger@vt.edu
[2] R.B. Annis School of Engineering, University of Indianapolis; reidk@uindy.edu
[3] Virginia Polytechnic and State University; akatz4@vt.edu
[4] School of Education, University of Indianapolis; jsomers@uindy.edu
* Correspondence: tgriesinger@vt.edu

Abstract: The number of engineers who are transitioning into environmental sustainability careers is growing, though a gap still exists between supply and demand. This presents an opportunity for undergraduate engineering students to fulfill the demand as environmental sustainability professionals. This qualitative exploratory study investigated environmental sustainability learning experiences and future career interests in environmental sustainability. The social cognitive theory (SCCT) was utilized as a theoretical lens, exploring undergraduate students' environmental sustainability interests, related learning experiences and their interest in pursuing a future career in environmental sustainability. Twenty-five undergraduate engineering students in various engineering disciplines were interviewed for this study. Data were analyzed to (1) identify students' interest in pursuing a career in environmental sustainability, (2) determine if students' interests have changed since they began their undergraduate studies, and (3) explore how learning experiences have impacted students' future career choice. The findings posit that exposure to environmental sustainability learning experiences is impactful and plays an important role, impacting students' interests in pursuing careers in sustainability. Results reveal that elements such as personal beliefs and salary considerations inspire career choices. This research contributes to addressing the demand for additional working professionals who are prepared to tackle environmental sustainability issues, highlighting the role of learning experiences in shaping students' career interests.

Keywords: environmental sustainability; engineering education; learning experiences; career interests

1. Introduction

From an increased frequency in extreme weather events to a rise in sea levels and damaging floods, changing climate impacts are unparalleled [1]. An unrelenting crisis is here. "Code Red for Humanity" is how our climate crisis was defined by UN Secretary-General Antonio Guterres in a UN report on the environmental danger issued in August 2021 [2]. The human element of climate change is affecting future generations and is a persistent issue facing the world [3,4]. Even though humans may be exacerbating climate change, they also have the potential for mitigation. There was a warning in the past, "if the present growth trends in world population, industrialization, pollution, food production, and resource depletion continue unchanged, the limits to growth on this planet will be reached sometime within the next one-hundred years" [5] (p. 23). Fast global changes are increasing the demands on multiple resources, while short-term management poses risks to the sustainability of both societies and ecosystems [6]. As shown in Figure 1, there are several sustainable development initiatives and mitigation efforts, as defined by the United Nations sustainable development goals [7], which can be considered when thinking about sustainability [8]. Each initiative or mitigation effort may contribute to sustainable development by meeting current resource needs without

 doi:10.20944/preprints202404.0505.v1

disturbing resources for future generations. The current "climate emergency" label shows that a shift in views of environmental sustainability has occurred since the previous crisis label [9]. To use the word emergency, rather than crisis is a strong statement, showing the urgency of this phenomenon. This current emergency may be the motivation necessary for action and timely for future engineers to address environmental sustainability issues throughout their careers. In preparation for this future, it would be valuable to gain a deeper understanding of the career planning factors considered by students who want to work on solutions in environmental sustainability. To address our current climate emergency, we have an opportunity to build on previous research on learning experiences [10].

Figure 1. UN Sustainable Development Goals, image adopted from https://www.un.org/sustainabledevelopment. The content of this publication has not been approved by the United Nations and does not reflect the views of the United Nations or its officials or Member States.

The integration of environmental sustainability learning experiences into undergraduate engineering education should be a priority because climate change is happening today, and future engineers may be able to solve climate related issues. Greater exposure to environmental sustainability learning experiences in undergraduate engineering education could help increase the number of future engineers who have a career interest in tackling environmental sustainability initiatives such as those outlined by the 2030 Sustainable Development Goals. These newly graduated engineers may help close the gap of increased need to fill new environmental sustainability related career vacancies. Because engineering students are trained to be problem solvers in their undergraduate studies, if we empower these students as change agents, some may choose the career path to be contributors of climate solutions. Students may gain the desire to tackle some of the United Nations Sustainable Development global challenges [11]. Some students may actively seek to create environmental sustainability solutions or others may modify their behaviors to avoid worsening current problems.

2. Materials and Methods

This exploratory study aimed to understand how learning experiences related to environmental sustainability in undergraduate studies inform their thinking about potentially pursuing careers in environmental sustainability. The following research question was explored:

RQ1: How is exposure to environmental sustainability learning experiences in undergraduate engineering courses associated with an interest in pursuing careers in an area of sustainability?

As described by Social Cognitive Career Theory (SCCT) and as illustrated in Figure 2, learning experiences are precursors to both self-efficacy and outcome expectations linking to student career

 doi:10.20944/preprints202404.0505.v1

choices. Data collected for this research provided insights into learning experiences and how students form career interests. Semi-structured interviews explored how students' learning experiences in undergraduate engineering inspired them to consider environmental sustainability career choices. Data collected informed how certain conditions may come to be, such as an interest in a future career in environmental sustainability, or if certain events have occurred, such as an environmental sustainability learning experience. Specifically, for this research, the learning experience construct as it relates to students' downstream career interest of the SCCT was explored. For this study, undergraduate engineering students enrolled in any engineering discipline at a large research-intensive institution in the United States who also enrolled in a green engineering minor who had generally completed 6 semesters of coursework were recruited for interviews. Purposeful sampling requires access to key informants in the field who can help in identifying information-rich cases. This sampling approach involved choosing participants who could be the most informative in this context. Sampling from this group of green engineering minor students provided responses from students who were at least familiar with environmental sustainability and were able to engage in a deep conversation about the topic. Recruitment for the semi-structured interviews was facilitated by inviting college students enrolled in the 3-credit course, ENGR3124 Introduction to Green Engineering during the Fall 2022 semester. Data for this exploratory research design was first collected by a pre-screening questionnaire and second through semi-structured interviews. The interviews were conducted and were uploaded to Dedoose, a qualitative data analysis software. A deductive approach was utilized for coding, based on the primary constructs of the SCCT. Additional codes then emerged during the iterative cycles of coding. Qualitative data from the semi-structured interviews were analyzed through the lens of the SCCT to understand how student's environmental sustainability learning experiences may have led to an interest to choose a future career in sustainability. Data analysis ran concurrently with data collection in iterative cycles. A provisional coding plan was utilized for data collected from the interviews, beginning with a list of codes generated from theory, and then allowing other codes to emerge [12]. The SCCT guided the first cycle of coding of the individual interviews focused on several of the SCCT constructs — person inputs, learning experience, self-efficacy, and outcome expectation — while also allowing space for other codes to emerge during the process by constantly comparing new codes with existing codes. To ensure trustworthiness for the qualitative coding, peer debriefing was utilized [13] and a sample of the excerpts were chosen and coded by two other researchers utilizing the established codes derived from the SCCT constructs and codes that emerged throughout the data analysis process for verification [14]. In addition, member checking was used throughout the interviews with an ongoing dialogue to ensure that the data's meaning was interpreted correctly. Interview participants were then given the chance to review a summary of their interview data after interview completion to check for the findings' accuracy [15]. A confirmation of accuracy was provided by 22 of the 25 participants and in three cases, minimal edits were provided.

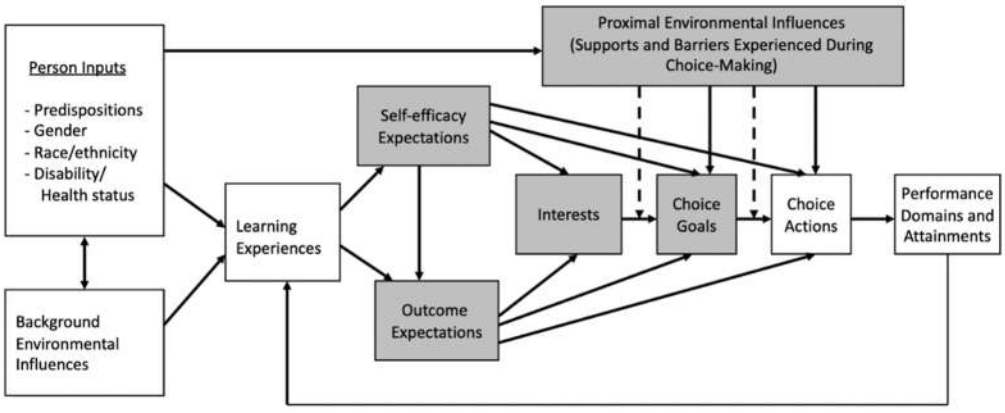

Figure 2. Social Cognitive Career Theory (SCCT) construct relationships, image adopted. Copyright 1993 by R.W. Lent, S.D. Brown, and G. Hackett. Reprinted by permission.

 doi:10.20944/preprints202404.0505.v1

This research presented both strengths and limitations. The student recruitment process was almost seamless, having unwavering support from the chair of the green engineering minor program during the process. Participant response rate was high, perhaps because students were interested in talking about their experiences or because they were incentivized for their participation. The virtual format for data collection through Zoom provided flexibility and logistical ease. The choice to interview students enrolled in the green engineering minor may have been a limitation due to their inherent biases and preexisting biases and interests in environmental sustainability. Future research will be beneficial to support the development of new strategies, including and beyond learning experiences, to encourage students to address sustainability related issues in their future careers.

3. Results

3.1. Learning Experiences and Future Career Interest

Several students recognized a change in interest in a future career in environment sustainability during their time in their undergraduate programs. Of those students, many recognized an increase in interest after taking coursework and envisioned their future career path. Of the students interviewed, one student reported no change in interest, about half of the remaining students expressed a gradual change and the other half noted a specific change. The following three scenarios speak to the following question, "How is exposure to environmental sustainability learning experiences in undergraduate engineering courses associated with an interest in pursuing careers in an area of sustainability?"

3.1.1. Scenario 1 (3rd Year Industrial and Systems Engineering Major):

Interviewer: Did you have any interest in pursuing an environmental sustainability career before starting your undergraduate program?

Then followed up with the following question:

Interviewer: Has this changed since you started taking courses?

Participant: "*No, I don't think I had that much of an interest but as and then I got to know about this through the courses that I've taken. And so, it's something that we have to be very serious about. So that caught my attention*."

Participant: "*It was last semester. It was last year when I was taking this course called Human Factors in economics. And that was where the first ideas of sustainability started going to me*."

The participant also indicated the following in their interview when asked what type of future career path they envision, their response:

Participant: "*I'm looking to concentrate more towards getting into the automobile industry. So, when I get into that I can, if I can work on the production line, make the production line gets faster. There's probably less electricity use, there's less wastage and even if there's some parts that go waste, I make sure that they are recycled. And talking about the engines that cars are gonna use and think we have to make better engines because I think 20% of the 10 to 20% of the world is running on electric vehicles right now. And even though they sound very good for the environment, the way those batteries are made are just not as good*."

3.1.2. Scenario 2 (3rd Year Aerospace Engineering Major):

In the second example, the participant identified that while taking a course, they first began to think about sustainability and then they also identified ways they may address environmental sustainability in their future career. They said that before their undergraduate years, they knew about environmental sustainability, though they didn't plan on pursuing it. This student then also identified when their mindset began to change and how they may contribute to environmental sustainability in their career.

Participant: "*Before coming to [university], I did, though I wasn't as focused on pursuing it as a part of my field, but it was kind of something that education or at least, culture had imprinted upon me*."

 doi:10.20944/preprints202404.0505.v1

Participant: "*I would say during the past semester, this past spring, so fairly recently. I decided that instead of just pursuing the construction of aircrafts or spacecraft, so I wanted to do something that would be a little bit more helpful for the future.*"

Participant: *"My direct contribution will probably be ensuring that to the best of my ability, I'm designing wind turbines to impact their surroundings less, operate more efficiently, generate more power so that they can be so that not only are we approaching a more sustainable energy source, but that energy source itself gets more sustained."*

These data from this participant suggests that during their time at the university, their interest has changed, and they identified how they may contribute to environmental sustainability in their future career.

3.1.3. Scenario 3 (4th Year Biological Systems Engineering Major):

The following participant provided this response when asked if they had an interest in environmental sustainability prior to attending the university, and they responded:

Participant: *"I definitely think that I had a lot of interest in the environment and the protection of it, but I don't think until I came to [university], that those two sides really came together for me. I never took any environmental classes in high school. I had never other than my own personal experiences with nature and being in it and like family homes, farms, and things that kind of I have that kind of background. Other than that kind of exposure I had never really looked at environmental engineering as a way of life. I was always more focused on the biotech side. But I mean even coming from the background, I have seen now from [biological systems engineering]. I have seen a lot more applications, even for biotech in this kind of environmental engineering side of things and how we can bring those two together and really any engineering once again, you are gonna have an impact on the environment. It's kind of one of those big common problems we all have to solve one of these days. So, anything you engineer always kind of has to have that in mind."*

When then asked if they could identify when this interest may have changed, they mentioned research as a part of the change in the following excerpt:

Participant: *"I don't think there was any one place where it really changed. I mean, there were a couple of different places where I saw it gradually grow more and more. I mean, I got research where I was doing looking at the effects of agriculture on groundwater. So that was one of my background things that I wasn't expecting to get. I did a watershed class. There were a couple of different professors who had more focus on the environmental side."*

The mention of professors who had more of an environmental focus is insightful. This influential notion, as illustrated by the SCCT framework, identifies supports and barriers that students experience during their choice-making process.

This participant then identified how they could contribute to environmental sustainability in their future career:

Participant: *"I've definitely thought about this and as far as it being my senior year, I have one more year left. I have a couple of options on the board. Part of me wants to go out west Colorado, Wyoming, work with an NGO or something. Help engineering, the national parks, that kind of stuff. Another part of me actually, my grandmother owns a small farm in South Africa. And there are certain things that have come to light where I might end up going over there for a couple of years after school and I kind of want to try and use what I've learned about sustainability, and the more agricultural background of what I've learned and possibly turn that to a sustainable Agricultural type. There's already an Airbnb there, spend a couple of years and see what I can do, given the learning that I have in a pretty impoverished area, both in the community and just on the land that I have there."*

This excerpt suggests that the student had an interest in environmental sustainability prior to attending the university, though they also recognized that research in a watershed course may have enhanced this interest. This participant also identified how they may contribute to environmental sustainability in their future career.

 doi:10.20944/preprints202404.0505.v1

3.1.4. Scenario 4 (3rd Year Civil Engineering Major):

The following participant identified when their interest in environmental sustainability developed in the following excerpt:

Participant: *"I think just like throughout my childhood my mom is always like, super big on like, making sure we like compost our like food waste instead of just throwing it in the trash and like recycling and like, like, learning water use not just because it's cheaper, but also because like, it's a resource, and she's just always like, like, kind of put it in our heads to that kind of thing".*

Then when asked if their view has changed, they responded:

Participant: *"I don't think I considered a focus on environmental sustainability; I think going into it I was just thinking of pursuing engineering and then I would find some one thing I liked along the way. My view has changed since taking the specific types of civil courses, especially intro courses, like Intro to Structures and Intro to Transportation has definitely given me a better idea of possible career paths. And then also, now that I'm starting to take a green engineering course, it's solidified my path."*

This quote is insightful as it describes the impact of introductory courses. The student recognized that the courses were not environmental specific, also aligning with student responses signifying the exposure and impact to environmental sustainability they also experienced in the engineering foundation courses.

This participant also described how they envision their future career path:

Participant: *"The path I'm going now, probably alternate modes of transportation and reducing the amount of people who use cars all the time and improving the bus systems and bike lanes, areas like that."*

Of the participants mentioned who could identify that a change in interest in environmental sustainability occurred, one student was able to identify a particular semester when the change took place, while the other students recognized a gradual increase over time since attending the university. It was also mentioned that the professor's focus on environmental sustainability made a difference.

Although the data identify differences in a change in interest, and when this may have occurred, each of the participants identified some type of change in interest since attending the university, along with detailed descriptions of their future career in environmental sustainability.

Students identified environmental sustainability predispositions they acquired prior to beginning their undergraduate engineering programs, identifying background and environmental influences. Students begin their undergraduate engineering programs with varying background and interests in the area of environmental sustainability and the level of exposure also varied by participant. It is clear from the data that some students were already exposed to environmental sustainability. For example, one participant mentioned learning about maintaining the environment while in the role of a camp counselor, learning about how humans and nature intermingle. Likewise, another participant talked about their experience in Boy Scouts when they learned about erosion and runoff, and yet another participant mentioned an impactful volunteer experience at a camp, growing their interest in environmental sustainability.

Participants identified a gamut of interests and ways that they could address environmental sustainability with their future engineering degree, in contexts such as improving life quality. Students identified topics such as designing environmentally friendly medical devices, pollution reduction, land and water preservation, renewable energy areas such as hydroelectric power, solar energy and wind power, manufacturing processes, environmental data collection from satellites and recyclables to name a few, highlighting the interdisciplinary locus of environmental sustainability.

Data acquired from one participant revealed a connection between exposure to environmental sustainability prior to college, then in introductory courses and a potential career path in environmental sustainability. The participants shared that they were exposed to composting and recycling during their childhood, then exposed to environmental sustainability during coursework, specifically during civil introductory courses. This student also expressed that they would like to work on alternative modes of transportation in their future career.

The importance of financial rewards while emphasizing making a difference was mentioned. Although not a common trend found in this research, this participant also expressed that they may be willing to accept a position which pays less if the tradeoff is meaningful work, "*I know this is gonna*

 doi:10.20944/preprints202404.0505.v1

sound really bad, but I mean, money is the driving factor and all of that, but at the same time, I'd rather have a job that I know that I'm making an impact in and take a pay cut for it, you know, and so, I think as long as I walk at the end of my career, and I retire as long as I can look back and say that I made an actual impact, a good impact on the world, then I'd be more than happy," demonstrating an intrinsic connection to career success. This view demonstrates that many of the students identified a successful career as one that provides monetary reward also while contributing to the greater good.

3.2. Findings

Each student interviewed has some level of interest in sustainability, which was derived from different types of learning experiences, at times occurring during their pre-college years along with experiences during their undergraduate years. In addition, multiple students could identify ways in which they would like to address sustainability issues in their careers, though both monetary rewards and intrinsic rewards were both mentioned.

All twenty-five students interviewed indicated they believe engineers can address environmental sustainability issues, also displaying their own confidence in their personal impact. They identified ways in which they, as future engineers, may contribute to an area of environmental sustainability. Students mentioned areas such as hydroelectric power, solar energy and wind power, manufacturing processes, environmental data collection from satellites and recyclables. In addition to monetary reward considerations, students also expressed that making a positive contribution is important in their future careers. There may be a misperception that a career in environmental sustainability may be less financially lucrative than other engineering disciplines.

In terms of learning experiences, some students mentioned pre-college exposure through camps, Boy Scouts, or self-directed learning. Academic learning experiences were impactful, as students mentioned various undergraduate courses where they have been exposed. The Introduction to Green Engineering course was specifically stated, though many students recognized the integration of environmental sustainability elements into other courses through videos, discussions of current events, guest speakers and projects. Internships expose students to real-life aspects of sustainability initiatives, oftentimes leading to a future position within the company.

Most students expressed a personal desire to contribute to an environmental sustainability cause in their future careers, though some acknowledged that at this point in their undergraduate studies, they were unsure exactly how they would do so. Many felt that they could make a positive impact in the world by contributing, seeing it as a noteworthy factor in their career aspirations. This is promising because engineers are trained problem solvers and future engineers would be excellent candidates to tackle sustainability related issues.

The change or progression of interest in environmental sustainability differed amongst participants, ranging from little interest to some interest when students began their undergraduate years. The evolution was documented with the following three examples:

Scenario 1: This student arrived at the university with little interest in environmental sustainability, an interest started to blossom while taking courses, and now the student envisions contributing to environmental sustainability with a future career in the automobile industry.

Scenario 2: In this instance, this student knew about environmental sustainability before starting their undergraduate program, but there was no plan to pursue it. They began taking courses and their mindset began to change. They now intend to contribute to an environmental sustainability initiative by designing efficient wind turbines in their future career.

Scenario 3: This student did have a slight interest in the environment prior to arriving to campus but didn't make a connection until attending the university. Their interest increased after taking some courses and they plan to work on improving alternative modes of transportation after graduation.

Scenario 4: In this instance, pre-college and familial experiences were impactful, then coursework had a striking effect.

Overall, a combination of pre-college experiences, academic coursework, extracurriculars and internships, all influenced students' career choices in this field. Although family influence was insignificant, informal conversations amongst family members may have sparked some interest in

 doi:10.20944/preprints202404.0505.v1

the area. Students recognized the important roles that their peers, professors, and mentors each play in shaping their future career path.

Results from this study imply that exposing students to environmental sustainability concepts in engineering programs does appear to inform students of opportunities and ways they may personally contribute after graduation.

4. Discussion

Information gathered from this study sheds light on students' interests in environmental sustainability and future career interests. This data may lead to the deliberate development of curriculum that supports additional environmental sustainability initiatives. During the interviews, students identified impactful learning experiences during their undergraduate years which influenced their interest to pursue a career in environmental sustainability. This research is important partly because societally, we have experienced a shift since the pandemic began transforming how people work, why they work and where they work [16] (*Global Green Skills Report 2022*, n.d.). The Great Reshuffle, as it has been referred to by LinkedIn:

> "is an unprecedented moment in history where we are reimagining the future of work. People are actively acquiring new skills and pursuing new ventures and employers are reinventing business models and creating new markets. This upheaval, which typically may play out over the course of decades, is being compressed into a couple of years" [16] (*Global Green Skills Report 2022*, n.d., (p. 3)

Amid this great career reshuffle, along with the COVID pandemic and the current climate crisis, we are faced with an opportunity to transition our society to a green economy, addressing the climate change warning. Achieving collective global climate targets is a colossal challenge and the undertaking is going to require a shared effort to make it happen. Our current undergraduate engineering students identified opportunities in which they can be change agents and contribute towards tackling these monumental global climate initiatives. Results from this study provide insight into dynamics that inspire career choices. Students' learning experiences may provide exposure to global issues that need solutions. Factors identified in this study could be considered and integrated into future environmental sustainability research, outreach, and initiatives. Engineering educators can expose students to environmental sustainability learning experiences within their curricula, which could result in increased interest in pursuing a career in environmental sustainability. These experiences could be shared amongst other engineering education communities to promote integrating environmental sustainability in their curriculum.

There are many contributing factors considered when considering a career. Overall, students mentioned that a combination of pre-college experiences, self-directed learning, and formal academic experiences have shaped their paths toward embracing environmental sustainability and choosing their future career path. This emphasizes the value of a well-rounded approach to sustainability education, integrating real-world exposure with personal interest, and structured academic learning. The learning journey is an active process, acquiring information and integrating with existing knowledge acquired along the way [17]. It may be inferred that precollege exposure to hands-on outdoor experiences is impactful on learning and may also develop future career interests [18].

Collectively, the students recognized that there are multiple ways to address environmental sustainability issues in their future careers, regardless of their engineering major. It is inspiring to witness students actively thinking about creating solutions for environmental sustainability issues. Students connected their interests, exposure, and potential career paths in environmental sustainability. Results from this study indicate that students want to make a difference in the world. The students in this study expressed that, although having a job is important, they would like a job that aligns with their personal values. As future contributors, the students have an awareness of the importance of environmental sustainability, and they would like to be a part of environmental sustainability solutions. As expressed by one participant, knowledge of environmental sustainability can be versatile, and this student is hopeful that they can practically apply their knowledge to have

 doi:10.20944/preprints202404.0505.v1

a lasting impact. The vision of the participants is inspiring, they are thinking about their place in the career world in the context of environmental sustainability.

An observation worth detailing, many students were able to identify how they may contribute, though they did not see a clear path to do so. This may be because the students are at different points in their undergraduate programs, and some of them still have time before they begin their post-graduation career search, or they have not decided. Either way, these results present an opportunity for university undergraduate engineering programs to increase exposure to sustainability-focused engineering profession related topics.

Although the undergraduate students interviewed in this study are motivated to make a difference in the world, money is still on their minds. While acknowledging money as a portion of success, most of the undergraduate students interviewed would like to employ their passions in their future careers in some way.

"Economic motivation is an impulse that arises from within to increase financial or financial needs" [19] (p. 2251). As Nilan et al. (2019) found while interviewing a group of university students, aged 21-22, higher salaries may outweigh other motivations. In contrast, another participant expressed that financial stability is an expectation after graduating with an engineering degree and pursuing their first post-graduation career. Nilan et al. found a similar trend that students may also have other motivations, meshed along with their financial considerations, revealing, "At the personal level, they were also concerned about under-employment, low income, low social status and family disappointment if they did not maximize the benefits of their degree in environmental engineering" [20] (p.1779).

The view of future monetary rewards aligned with most participants, indicating that they would like to address environmental sustainability issues in their careers while being compensated accordingly. This may also signal that students feel that the opportunity for an engineer to work for the betterment of society may be at a financial disadvantage, which may be a misconception about a career in sustainability.

5. Conclusions

The multifaceted nature of students' career choices in environmental sustainability is an undeniable reality. A student's decision-making process is clearly influenced by many factors, each playing a distinct role. The influences motivating students to pursue careers in environmental sustainability are complex, and this study illuminated several key aspects that play a role in shaping students' career decisions. In particular, the students considered personal values, environmental sustainability learning experiences and monetary gains when thinking about a future career in environmental sustainability. There may be a misperception present that a career in environmental sustainability will not yield a satisfying monetary gain.

The exploratory evidence indicates there is room for further research in this area. Although the results from this study did not indicate that learning experiences were the only factors that contributed to student career interests, results did reflect that exposure to environmental sustainability in various settings did spark or increase an interest. In the undergraduate educational setting, the knowledge gained, and opportunities encountered contributed to the student's inclination towards considering a future career in environmental sustainability. Students could also connect their future engineering degree and how it could be used to tackle environmental sustainability issues. The data revealed that students do see themselves as engineers, paired with adequate corresponding salaries while making a difference. The students have a desire to make a difference in the world, though money was a factor in most cases. This essential notion reflects the student's enthusiasm and willingness to work on environmental sustainability issues if they are adequately compensated for their efforts.

Author Contributions: Conceptualization, T.G.; methodology, T.G.; formal analysis, T.G.; data curation, T.G.; investigation, T.G.; resources, T.G.; writing—original draft preparation, T.G.; writing—review and editing, T.G., K.R. and D.K.; J.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: It was determined that this activity is not research involving human subjects as defined by HHS and FDA regulations.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Dataset available on request from the authors.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Apollo, A., & Mbah, M. F. (2021). *Challenges and opportunities for climate change education (Cce) in East Africa: A critical review*. In Climate (Vol. 9, Issue 6). MDPI AG. https://doi.org/10.3390/cli9060093
2. Roscini, F. (2021). *UN Research Shows Climate Change is "a Code Red for Humanity*." Global Development Policy Center. https://www.bu.edu/gdp/2021/10/22/un-research-shows-climate-change-is-a-code-red-for-humanity/
3. Cook, John; Nuccitelli, Dana; Green, Sarah A.; Richardson, Mark; Winkler, Barbel; Painting, Rob; Way, Robert; Jacobs, Peter; Skuce, Andrew. *Environmental Research Letters*, January 2013. https://doi.org/10.1088/1748-9326/8/2/024024 Environ. Res. Lett., vol. 8, no. 2, p. 024024, Jun. 2013, doi: 10.1088/1748-9326/8/2/024024.
4. Stocker, T. F., d. Qin, G.-K. Plattner, M. M. B. Tignor, S. K. Allen, J. Boschung, A. Nauels, Y. Xia, v. Bex, and P. M. Midgley. (2014). *Climate Change 2013: The Physical Science Basis. Students' evaluations about climate change* Doug Lombardi, Carol B. Brandt, Elliot S. Bickel & Colin Burg.
5. Meadows, D.H., Meadows, D.L., Randers, J. and Behrens, W. (1972). *The Limits to Growth*. Universe Books, New York.
6. Meadows, D., Randers, J., and Meadows, D. (2004). *The Limits to Growth: The 30-Year Update.* London: Earthscan.
7. Van Ruijven, B. J., De Cian, E., & Sue Wing, I. (2019). Amplification of future energy demand growth due to climate change. *Nature communications*, *10*(1), 2762.
8. Liu, Q. (2016). *Interlinking climate change with water-energy-food nexus and related ecosystem processes in California case studies*. In Ecological Processes (Vol. 5, Issue 1). Springer Verlag. https://doi.org/10.1186/s13717-016-0058
9. McHugh, L. H., Lemos, M. C., & Morrison, T. H. (2021). Risk? Crisis? Emergency? Implications of the new climate emergency framing for governance and policy. *Wiley Interdisciplinary Reviews: Climate Change*, *12*(6), e736.
10. Schaub, M., & Tokar, D. M. (2005). *The role of personality and learning experiences in social cognitive career theory*. Journal of Vocational Behavior, 66(2), 304–325. https://doi.org/10.1016/j.jvb.2004.09.005
11. Zarestky, J., & Collins, J. C. (2017). Supporting the United Nations' 2030 sustainable development goals: A call for international HRD action. *Human Resource Development International*, *20*(5), 371-381.
12. Saldana, J. (2016). *The coding manual for qualitative researchers*. Sage Publications.
13. Stahl, N. A., & King, J. R. (2020). Expanding approaches for research: Understanding and using trustworthiness in qualitative research. *Journal of Developmental Education*, *44*(1), 26-28.
14. Creswell, J. W. (2007). *Qualitative inquiry & research design: Choosing among five approaches*.
15. Creswell, J. W., & Creswell, J. D. (2018). *Research Design, Qualitative, Quantitative and Mixed Methods Approaches* (Fifth). Sage.
16. LinkedIn Economic Graph. (2022). Global Green Skills Report 2022.
17. Korte, R., & Smith, K. (2007, June). Portraying The Academic Experiences Of Students in Engineering: Students' Perceptions Of Their Educational Experiences And Career Aspirations In Engineering. In *2007 Annual Conference & Exposition* (pp. 12-1162). Kyoung Ro, H., Lattuca, L. R., & Alcott, B. (2017). *Who Goes to Graduate School? Engineers' Math Proficiency, College Experience, and Self-Assessment of Skills*. *Journal of Engineering Education*, *106*(1), 98–122. https://doi.org/10.1002/jee.20154
18. Temes, J. (2016). The impacts of a pre-college outdoor adventure trip on the college experience at the University of Colorado Boulder.

 doi:10.20944/preprints202404.0505.v1

19. Ardiyanto, J. (2021). Effect of Education Costs, Career Motivation, Family Environment on Students Interest: A Case Study of Radiological Engineering Diploma Students in Indonesia. *NVEO-NATURAL VOLATILES & ESSENTIAL OILS Journal| NVEO*, 2249-2259.Arima, A. (2009), *"A plea for more education for sustainable development"*, Sustainability Science, Vol. 4 No. 1, pp. 3-5.
20. Nilan, P., & Wibawanto, G. R. (2019). Career quandaries of activist environmental engineering graduates in indonesia. *Environmental Education Research, 25*(12), 1775–1789. https://doi.org/10.1080/13504622.2019.1648769