UNVEILING CONNECTIONS INTEGRATING CLIMATE STUDIES AND CYBERSECURITY EDUCATION

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Abstract

The aim of this paper is to use patterns to suggest the introduction of a new minor program in climate studies at a major university, emphasizing its interdisciplinary nature and the benefits it offers to students. Future plans include the development of a major in Climate. The primary goal is to emphasize the significance and pertinence of addressing climate change using an interdisciplinary framework, highlighting the potential of incorporating this minor to make optimal use of current course design patterns. By offering a minor in climate, students will have the opportunity to explore the study of climate change, its consequences, and the creation of sustainable solutions. Additionally, it will foster a comprehensive understanding of the intersection between technology and environmental challenges, equipping students with valuable knowledge for the future. Climate change is one of the most pressing issues of our time. The climate change minor gives the students the opportunity to explore climate change from varied disciplinary perspectives while gaining a firm grounding across all academic departments including African American studies, architectural technology, biological science, business, chemistry, computer systems technology (CST), physics, dental hygiene, math, English, Social Sciences, nursing - to name a few. Students from all academic departments can apply for the minor in climate change. One of the program's goals will be to describe the physical mechanisms that underlie climate change and the drivers of uncertainty in future climate projections. Alexander writes, "There is one timeless way of building. It is thousands of years old, and the same today as it has always been. The great traditional buildings of the past, the villages and tents and temples in which man feels at home have always been made by people who were very close to the center of this way. And as you will see, this way will lead anyone who looks for it to buildings which are themselves as ancient in their form as the trees and hills, and as our faces are."[1] The climate is thousands of years old; Alexanders's principles can guide the design and structure of the proposed minor. This paper will employ Alexander's principles to help create that new course, a minor in climate. The students will relate climate and cybersecurity, which many did not believe had any relationship.[1] The target audience of this paper includes educators seeking to implement innovative curricula, prospective students interested in exploring climate studies, and patterns enthusiasts.

Specifically, the main focus of this paper is the computer systems technology department and the introduction of information for a security course. The proposed minor extends its implications to a broader range of academic departments within the college.

Keywords: Patterns, environment, cybersecurity, climate studies, interdisciplinary education, course design, climate change, pedagogical patterns, sustainable solutions.

1 INTRODUCTION

Climate and cybersecurity are two distinct but interconnected areas of concern in today's world. While they may seem unrelated at first glance, they intersect and influence each other in several important ways. Although climate change and cyberspace are different phenomena, the risks associated with both are anthropogenic and can affect the same critical equities including key sectors such as water, food and energy infrastructures.

Anthropogenic environment refers to human-induced environmental changes. Examples of anthropogenic environments can be divided into broad categories: pollution, land-use change (including habitat loss and fragmentation), climate change, overexploitation of natural resources, and the introduction of invasive alien species. The integration of climate and cybersecurity is of paramount importance in addressing the pressing challenges of the modern era, as it not only safeguards critical infrastructure against cyber threats, but also enhances resilience in the face of climate change, ensuring sustainable development and global security. For example, hurricane Sandy hit New York on October 29, 2012, major data centers were affected, leading to internet disruptions. Natural extreme weather events can damage physical infrastructure leaving them vulnerable to attack. Lower Manhattan was

without power from 39th street down. The pressing need to confront climate change and the importance of cybersecurity education in our contemporary, highly interconnected world cannot be overstated.

Environmental Impact on Cybersecurity: Climate change and its associated consequences, such as extreme weather events, can have a direct impact on cybersecurity. Disruptions caused by natural disasters like hurricanes, floods, or wildfires can damage critical infrastructure, including data centers and communication networks. Such incidents can lead to service outages, data loss, and even breaches in security, leaving organizations vulnerable to cyberattacks. Environmental disruptions can lead to physical damage, resource scarcity, and increased vulnerabilities in cybersecurity, topics that will be explored in greater detail in the paper.

Cybersecurity Risks to Climate Infrastructure: As the world becomes more reliant on interconnected systems for managing climate-related infrastructure, such as smart grids, renewable energy networks, and environmental monitoring systems, the risks of cyber threats increase. Unauthorized access, data manipulation, or sabotage of these systems can have far-reaching consequences, disrupting energy supply, impeding climate research, or affecting emergency response capabilities. Disaster management, and sustainable practices to address the challenges posed by climate change can be taught, in a course, to the students. We do this now, but we don't emphasize climate. In a region heavily reliant on renewable energy sources like wind and solar power, there is a well-connected and automated energy grid that balances the production and distribution of electricity from various sources. This grid relies on interconnected systems, including smart meters, sensors, and control systems, to optimize energy production and manage demand. A Cyberattack on a renewable energy grid where a malicious actor launches a cyberattack targeting this renewable energy grid.

Data Privacy Concerns: Sensitive data collection in climate research involves the acquisition of information that is confidential, proprietary, or personally identifiable and is subject to stringent ethical, legal, and privacy considerations. Students might need IRB (Institutional Review Board) approval for data collection. Climate-related initiatives often involve the collection and analysis of large volumes of sensitive data, such as personal information, geographic data, or climate modelling data. Protecting this data from unauthorized access or breaches is crucial to maintain privacy and preventing potential misuse. Robust cybersecurity measures are necessary to safeguard this information and maintain public trust in climate-related initiatives.

Interconnectedness of Global Issues: Climate change is a global challenge that requires international cooperation and information sharing. Similarly, cybersecurity threats know no boundaries and require collaborative efforts to combat them effectively. Addressing both climate change and cybersecurity necessitates cooperation among governments, organizations, and individuals to develop shared strategies, policies, and frameworks. The United Nations works with various countries to create climate change partnerships by drawing upon knowledge and expertise to promote positive, solutions-driven approaches to combat climate change.

Green Technologies and Cybersecurity: The adoption of green technologies, such as renewable energy sources and energy-efficient infrastructure, is vital for mitigating climate change. However, these technologies also introduce new cybersecurity challenges. For instance, the increased use of Internet of Things (IoT) devices and cloud-based systems in smart grids and renewable energy networks can create vulnerabilities that cybercriminals can exploit. Building resilient and secure infrastructure is essential to ensuring the sustainable deployment of green technologies. Green technologies, such as smart grids, introduce vulnerabilities that cybercriminals could exploit to disrupt energy distribution, manipulate grid operations, or compromise critical infrastructure.

This paper employs pedagogical patterns, such as "New Pedagogy for New Paradigms" and "Abstraction Gravity", to design the structure of the proposed minor in Climate Studies. The integration of climate and cybersecurity will be explored, illustrating the unexpected connections between these seemingly unrelated fields. The proposed minor extends its implications to a broader range of academic departments within the College of Technology, fostering collaboration and interdisciplinary learning.

In summary, climate change and cybersecurity are interconnected through their impact on critical infrastructure, data privacy concerns, the need for international collaboration, and the challenges posed by emerging green technologies. Addressing these interdependencies is crucial for building a resilient and sustainable future that is both environmentally secure and cyber resilient.

I used the Invisible Teacher pattern [2] for active learning to emphasize ACTIVE STUDENT. Usually, the teacher is the central point of a training environment. A discussion forum was created for the students.

2 METHODOLOGY

Creating a methodology for integrating climate studies and cybersecurity education involves carefully designing a systematic approach to address the intersection of these two domains. A needs assessment, curriculum alignment, interdisciplinary content development, skill mapping, pedagogical approaches, technological integration, cross-disciplinary collaboration, assessment and evaluation, continuous improvement, implementation and scaling, community engagement.

3 RESULTS

The committee was formed in June 2023. We are still working to complete the elements of the methodology. The current plan is to create an interdepartmental minor in climate studies at first and eventually create a new major.

3.1 Needs Assessment

Identify the key stakeholders, including educators, climate scientists, cybersecurity experts, and relevant policymakers. Conduct surveys, interviews, or workshops to understand the current state of climate studies and cybersecurity education. Determine the existing gaps, challenges, and opportunities for integration. During the Spring semester of 2023, 24 students in the introductory cybersecurity course were part of a survey.

3.1.1 Abbreviations and Acronyms

IRB – Institutional review board

3.1.2 Tables

Table 1 based on UN.org data

Causes of Climate Change	***Effects of Climate Change***
Generating power	Hotter temperatures
Manufacturing goods	More severe storms
Cutting down forests	Increased drought
Using transportation	A warming, rising ocean
Producing food	Loss of species
Powering buildings	Not enough food
Consuming too much	More health risks
	Poverty and displacement

3.2 Curriculum Alignment

Review existing climate studies and cybersecurity curricula. Identify common themes, concepts, and skills that can be integrated. Develop a curriculum framework that highlights the intersection points between climate studies and cybersecurity. This process is currently underway.

3.3 Interdisciplinary Content Development

Collaborate with subject matter experts in both climate studies and cybersecurity to create interdisciplinary content. Our provost has met with the Columbia University Dean. Develop case studies, scenarios, and projects that illustrate real-world applications of cybersecurity principles in the context of climate studies. This process is currently underway.

3.4 Skill Mapping

Identify and map the specific skills and competencies needed for professionals working at the intersection of climate and cybersecurity. Ensure that the integrated curriculum addresses these skills, encompassing both technical and interdisciplinary skills. We are creating a rational for the new minor.

3.5 Pedagogical Approaches

Select appropriate teaching and learning methods that foster engagement and understanding in both climate studies and cybersecurity. Consider experiential learning, hands-on projects, and collaborative activities to enhance the learning experience. This is occurring now within the departments.

3.6 Technological Integration

Explore the use of technology to enhance the learning experience, such as simulation tools, data analytics platforms, and virtual environments. Integrate cybersecurity tools and practices for securing climate-related data and systems. This will take place in the spring of 2024.

3.7 Cross-disciplinary Collaboration

Establish mechanisms for collaboration between climate studies and cybersecurity departments or experts. Encourage joint research projects, seminars, and workshops to facilitate knowledge exchange. We have assembled a team of faculty across the college and are meeting to determine which courses will be included in the minor.

3.8 Assessment and Evaluation

Develop assessment methods to measure the effectiveness of the integrated curriculum.

Incorporate both formative and summative assessments to gauge student understanding and skill development. This is to be determined.

3.9 Continuous Improvement

Collect feedback from students, educators, and stakeholders to continuously refine and improve the integrated approach. Stay updated on advancements in both climate studies and cybersecurity to incorporate relevant changes into the curriculum.

3.10 Implementation and Scaling

Pilot the integrated curriculum in a controlled environment. Evaluate the outcomes and make necessary adjustments before scaling the program to a broader audience. This will occur next fall 2024.

4 CONCLUSIONS

The most difficult aspect of understanding design and design thinking is not the thinking, it is the mind you think with [4]. It is the worldview: what is known and real, what is valuable and how things are done. You are teaching something new to you. The thing you need to teach has characteristics different from what you are used to, requiring different thinking modes on the part of users.[3] The pattern author, is discussing teaching functional programming. Here, we are incorporating climate as a study. Match the pedagogy to the thinking modes required in the paradigm you are teaching [3]. The potential impact of the proposed minor in climate studies could lead to a major in climate studies. Students will benefit by learning cutting edge technology and life-changing concepts. This minor will contribute to the overall education and development of individuals in many ways. Maybe with less pollution and a better climate we will have less cancer. Design thinking can be employed to bridge the gap between climate studies and cybersecurity education by fostering innovative solutions that address the intersection of these two fields. By applying design thinking principles, educators, researchers, and industry professionals can foster a holistic approach to addressing climate-related challenges while strengthening cybersecurity education, ultimately creating a more resilient and environmentally responsible future.

How can we distinguish patterns that work? Are the patterns working? If not, how are they coming short and how might they be improved? How can we distinguish patterns which work, which are deep and worth copying, from those which are simply pipe dreams, mad imaginings or irrelevant. One test says that a pattern is alive if its individual statements are empirically true. But a pattern is not alive just because its component statements are true, one by one. Even though its individual component statements are true, the pattern has no empirical reality. Even the fact that a pattern seems sensible, and has clear reasoning behind it, does not mean at all that the pattern is necessarily capable of generating life. A pattern only works, fully, when it deals with all the forces that are actually present in the situation [1] and alters for the good.

Today, we stand at a critical juncture where the choices we make have profound implications for the world we pass on to future generations. We have a unique opportunity before us - the proposal for a minor program in climate studies. This initiative isn't about adding another line to our academic offerings; it's about preparing ourselves and the generations to come for the challenges of our time. Young people think climate change is a top issue, but when they vote, it is complicated. Over the last decade, climate change has emerged as a top political issue, particularly for younger voters. But polls routinely show climate change lags other items, like traditional pocketbook economic issues, that can motivate voters. Do we care about the climate? The importance of this proposed minor program cannot be overstated. Climate change is no longer a distant threat; it is happening now, affecting ecosystems, economies, and communities worldwide. To navigate this crisis, we need more than just awareness; we need expertise, solutions, and innovation. The minor is the first step. Imagine a future where graduates from our institution possess a deep understanding of climate science, sustainability, and the intricate connections between climate change and cybersecurity. These future leaders will be equipped to tackle complex issues, find innovative solutions, and shape policies that safeguard our planet._How do you talk to a voter? Pocketbook economics, same technique applied. Two subjects seem quite different but are connected. Educating the voters. Environmental activists need to work more. Still a disconnect. Not just limited to academia and making new courses.

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