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Merging Systems Thinking with Entrepreneurship: Shifting Students' Mindsets towards Crafting a More Sustainable Future

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Abstract: The major challenges confronting humanity are systemic in nature: climate change, pollution, poverty, and inequality. Entrepreneurship fails to tackle these challenges, and 'creative destruction' is mostly just leading to the destruction of the natural world that we inhabit. The present economic, financial, and productive systems can and should be transformed to lead and power a shift towards sustainability. If we are to reverse the course of destruction that current capitalist systems are creating, we need to introduce more of a systems perspective into entrepreneurial education. This article addresses how merging systems thinking and entrepreneurship can be used to nudge students towards sustainability. Through a single case study, we argue that a practice-based pedagogy that combines perspectives from entrepreneurship and systems thinking can be used as a catalyst to bring about local changes in business models by making the business case go beyond the individual organization and seeing entrepreneurship as being about creating more sustainable business systems.

Keywords: systems thinking; entrepreneurship; sustainability; experiential learning

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1. Introduction

The world faces many challenges—climate change, plastic pollution, and inequality, to name a few [1–3]. These challenges are systemic in nature, and are made up of a complex interconnecting web of stakeholders with differing interests and incentives [4]. These are the types of issues to which systems thinking has traditionally been applied [5]. Resolving these challenges will therefore require a systemic solution. The present economic, financial, and productive systems can and should be transformed to lead and power a shift towards sustainability [1]. The question then becomes how to do this.

Traditionally, entrepreneurship has played a key role in transforming markets through the introduction of innovative products and services [6]. The forefather of entrepreneurship as a field, Joseph Schumpeter, famously described this change making process as the perennial gale of creative destruction, as entrepreneurs and firms continue to act entrepreneurially through innovation in search of sustainable profitability [7,8]. While much has been written about the term, at the core of the message is that entrepreneurs are the catalyst that bring about the destruction of old economic patterns through the creation of new enterprises [7]. Yet, if we review entrepreneurial progress in the last decades, there might be cause for concern [2]. The largest successful entrepreneurial firms such as Facebook, Apple, Tencent, Alibaba, Microsoft, etc., have amassed huge amounts of wealth, symbolizing their popularity and their success as economic organizations. Yet, none of them have as a primary or even secondary focus the resolution of the serious social issues facing the world. With a certain amount of greenwashing involved, there might be arguments made for the good they are having on the world, although we would posit that this is merely lip service [9]. It seems the perennial gale of creative destruction is mostly leading to the destruction of the natural world that we inhabit.

There is a growing recognition of the need to change the way the current economic system operates in order to resolve the serious issues facing the world [1]. In referring to the current economic systems and capitalism in general, we acknowledge there are variations in capitalism across regions and countries. We use the terms economic system and capitalism interchangeably to refer to the largely neoliberal markets of developed countries, such as those in western Europe and North America, although we do not consider the issues mentioned to be solely with these types of capitalism. Capitalism has many benefits, as evidenced by its ability to lift more than a billion people out of poverty at the start of the millennium [10]. Yet, even the earliest thinkers around capitalism saw the issues with unbridled capitalism, with Adam Smith and Karl Marx discussing accumulation of wealth (inequality) and externalities (pollution and destruction of nature) as being logical outcomes of the system. While capitalism has changed its form considerably since these thinkers raised their concerns, the issues they mention are as relevant today.

As is often quoted in systems thinking, a system operates exactly as it is designed to, and the issues in the world we are currently seeing are the clear result of the economic system being designed to create such issues [11]. Therefore, if we want our economic systems to behave differently, then we have to begin to design them differently.

One of the greatest points of leverage for changing a system is to focus on changing the mindsets of those involved in the system [12]. If we are to reverse the course of destruction that current capitalist systems are creating, and instead replace it with something more sustainable, then we argue that we need to introduce more of a systems perspective into entrepreneurial education [13]. This will in turn transform students' mindsets to having a more holistic view of the role of entrepreneurship in creating a sustainable future. We use a teaching case to demonstrate what the merging of these perspectives would look like, in the hope that inspiring a shift in mindsets will lead students towards being catalysts and creators of new more sustainable economic systems [14]. The case demonstrates how a practice-based pedagogy combines these perspectives as an initial step towards bringing about local changes in business models by making the business case go beyond the individual organization.

In order to argue for the combination of entrepreneurship with systems thinking, we begin with a brief overview of both systems theory perspectives and entrepreneurship. We then provide a merged theoretical perspective of the two fields, before demonstrating through a case study of how this can be taught as a practical hands on pedagogy. Lastly, we follow this with a reflection on the challenges and limitations of such an approach, along with suggestions for future research.

2. Systems Thinking and Entrepreneurship

As Meadows pointed out, "hunger, poverty, environmental degradation, economic instability, unemployment, chronic disease, drug addiction, and war, for example, persist in spite of the analytical ability and technical brilliance that have been directed toward eradicating them" [15] (p. 5). These are systems problems that, as she addressed, will not disappear until someone finds "the courage and wisdom" to restructure these systems.

Systems thinking is rooted in the understanding that society is so complex that linear ways of thinking and analyzing problems are insufficient and even counterproductive. Systems thinking has been developed based on the understanding that it is not enough to study only parts and processes in isolation; instead, there is a need to solve problems while considering the dynamic interaction of parts [16,17].

> *Similar general conceptions and viewpoints have evolved in various disciplines of modern science. While in the past, science tried to explain observable phenomena by reducing them to an interplay of elementary units investigable independently of each other, conceptions appear in contemporary science that are concerned with what is somewhat vaguely termed "wholeness"* [16] (pp. 36–37).

Von Bertalanffy [16] describes how systems thinking is a collection of methods, concepts, and techniques that are used to understand a phenomena where there are strong

interactions between different parts that together make up complex systems like those in entrepreneurial studies and sustainable development.

Classic systems thinking literature focuses on balancing forces and counter forces in order to uphold an equilibrium, which adequately explains how the current social issues already mentioned have come to be. Newer literature, such as Cabrera [18,19], point towards a better understanding of the complexity in the models and thus developing more enhanced mental models (we use mental models refer to 'deeply held internal images of how the world works' [11] (p. 174)). The challenge lies in the fact that when we change a system, it is difficult to predict the effects that will result from those changes. A singular change can have flow on effects, leading to second, third, and nth order consequences [20,21]. This is not something readily discussed in entrepreneurship literature, meaning entrepreneurs' mental models are not well equipped to see the consequences of any new service or product that they may launch. Entrepreneurship as a field does not train nascent entrepreneurs to see the totality of their choices.

Entrepreneurship may be understood as a system or network of interconnected actors, intimately related to today's complex societal challenges like sustainability. Yet, this is a topic that is rarely discussed within teaching environments. A systemic literature review of entrepreneurship education [22] makes no mention of 'sustainability' and only a passing mention of social entrepreneurship, while a more recent article [23] focusing on the role of UK entrepreneurship centers in higher education uses the word 'sustainability' only in relation to 'financial sustainability'. A surface review of three core journals focusing purely on entrepreneurship (Entrepreneurship Theory & Practice, Journal of Business Venturing, and the Journal of Small Business Management) reveals that since 2010, there have collectively been 38 articles with the word 'sustainability' in the title. We are conscious that a more thorough review would have revealed more articles, and that there are smaller niche fields such as 'sustainopreneurship' springing up (only 165 results in google scholar since 2010), but this term is totally absent from articles published in the three key journals mentioned. We do not mean to imply there is no literature linking sustainability and entrepreneurship. The point is that sustainability has not been part of the core discussion occurring within mainstream entrepreneurship journals and has traditionally been absent from the curriculum being taught to students of entrepreneurship [24].

However, attitudes have been rapidly changing, with new programs sprouting up that focus on the intersection of entrepreneurship and sustainability [25]. The point is that if we want students to begin to see the environmental consequences of the economic choices they make, then we need to begin to train entrepreneurs to think differently and more systemically [26], or at least to think more widely in their perspective. A systemic perspective on entrepreneurship indicates a need to explore and discuss more of what relates to or affects the whole of the system the entrepreneur is targeting [27,28].

The systemic perspective is embedded in the concept of sustainability introduced in the UN World Commission on Environment and Development report 'Our common future' [29], warning of the necessity of making progress toward an economic development that can be sustained without depleting natural resources or harming the environment. The UN Sustainable Development Goals, the Paris agreement, and the two degree scenario (International Energy Agency, 2017) all require policy actions and an array of public and private support across all innovation stages, from strategically directed research & development (R&D) and market creation and technology-specific support towards holistic support and market pull policies and system integration [30] (p. 10). The situation requires an entrepreneurial mindset that grows beyond an economic viable product and company and that embraces a systems-wide approach to change.

The idea of sustainable entrepreneurship is based on a development paradigm that recognizes that entrepreneurship makes an important contribution to environmental, social, and economic development. Yet, it still views the value creation unit at the level of the individual organization [31] and largely ignores the wider systemic implications. As such, it sticks with a more traditionally linear mindset that ignores the kind of 'wholeness' [16]

we referred to earlier. Systems thinking can be used to provide a new perspective and tools to broaden the field of influence entrepreneurs consider when innovating.

3. Previously Disconnected Literature and Mental Models

The connection between systems thinking and entrepreneurship is not entirely novel, although literature from the two fields is seldom sighted together. Initial conceptual work examining the connection between social entrepreneurship and systems thinking posited that a lack of understanding of social systems caused many social enterprises to fail [32]. We agree with this point, but note that the authors are still focused on the success of individual organizations and less on the systemic impacts of these organizations and ensuring that those systemic influences are positive.

Social enterprises are those whose main purpose is not just economic gain, but rather that they try to bring about social 'good' at the same time. The rise in popularity of social enterprises has resulted in a plethora of terms such as 'social purpose venture', 'community wealth venture', 'non-profit enterprise', 'venture philanthropy', 'caring capitalism', and 'social enterprise' [33]. Although, not all efforts to be socially responsible have been equally genuine, with many companies carrying out 'pseudo branding' in their attempt to appeal to consumers as socially responsible [32]. We suggest that minor changes in business models towards less damage or mild positive impacts does not go far enough towards supporting sustainability.

While Triverdi and Misera [32] are focused on social entrepreneurship, many of their arguments apply equally to the more mainstream field of entrepreneurship. They criticize academia for conceptual ethnocentrism, whereby traditional business management concepts are given undue weight and lead to mental models that concentrate on personal gain. Indeed, economics encourages people to be wealth-maximizing individuals because it is considered the rational thing to do (although this doctrine has been giving way to more relaxed positions that include space for human 'irrationality'). In pushing these forms of narrative, the result is that there is a tendency in academia and in classrooms to promote the idea of entrepreneurship being closely connected to personal wealth generation.

Yet, studies examining the motivations of entrepreneurs and student entrepreneurs [34,35] have shown that financial rewards are not the main motivators of those with entrepreneurial aspirations. Instead, factors like freedom, challenge, and the pursuit of meaning are themes that are conveyed as motivating nascent entrepreneurs.

Wealth maximizing mental models taught (consciously or unconsciously) to students can cause them to see the value of a forest as being based only on the lumber that it can produce, instead of seeing the inherent value in natural systems. A basic tenet in systems thinking is that optimizing for a singular metric results in a suboptimal performance of the entire system [11,17]. Accepting that businesses are part of economic and environmental systems leads to the conclusion that optimizing for individual performance in individual organizations will come at the expense of the entire system (even if it benefits the individual business owners/entrepreneurs). The current mental models being taught to entrepreneurs contribute to the further destruction of the environment as entrepreneurs strive to optimize the performance of their enterprises.

The result of these mental models has seen the increase in commercial activity, with phrases like hypercompetition being coined [36]. As Schumpeter predicted, as this commercialization speeds up and hypercompetition takes place, it gets harder for firms to maintain a competitive advantage [7]. We do not wish to sound like the American Patent Office in 1899, who said there was nothing left to invent. There is of course still room for further creative destruction in the deliverance of new industries and the creation of more artefacts for consumption. Yet, there is also the question of how much more the natural world can tolerate of this development before triggering a crash of ecosystems.

We should not need to be reminded that it is the economic system that is dependent on the natural world for survival and not the other way round [37]. If we are to continue with our current trajectory of singular focus, then it would stand to reason that we would push

our planet to the point that we risk our own destruction. In addition, the hypercompetition referred to puts pressure on margins, meaning there are incentives to choose the cheapest inputs, which often correlate with the most negative environmental outcomes, creating a re-enforcing feedback loop in the destruction of the planet.

It is therefore not sufficient to focus on businesses that have an incremental approach to improving environmental outcomes, although we commend those businesses that endeavor to limit their negative outcomes. Instead, we need to begin to redesign business as we know it to have a benefit to the environment, other businesses, and to multiple stakeholder groups connected or impacted by the business. Hence, there is a clear need to begin to provide aspiring entrepreneurs with new knowledge, such as a focus on 'wholeness'. We argue that theories of systems thinking can be used to shift the mental models of aspiring entrepreneurs towards a more sustainable orientation.

4. Applying Systems Thinking to Entrepreneurship

In aiming to combine the fields of systems thinking, entrepreneurship and sustainability, we encounter an issue at the level at which we are theorizing. Sustainability is an outcome, while systems thinking is a theoretical model. Entrepreneurship is about taking action under uncertainty [38], although is supported by a broader field of theory. We suggest that through shifting mental models of entrepreneurs by including systems thinking theory, we can create sustainable outcomes. Therefore, this section aims to assimilate the two disparate fields of entrepreneurship and systems thinking theory; the choice of which theory elements to join is entirely arbitrary. The decision as to which elements to discuss was based purely on the authors subjective perception of which elements seemed to have a natural cross-over. This is not an exhaustive review of either field, but rather an initial attempt to pair the two fields with the goal being to shift the mental models in aspiring entrepreneurs away from their singular focus on economic benefits.

4.1. Disconnected vs. Interconnectedness—Rather Than Seeing Individual Elements, Instead Focus on the Interconnection

In systems thinking, the focus is on the 'whole' [16], while what is meant by the whole can vary vastly depending on the level of analysis. To use an organizational example, you might consider a whole team, or a whole division or a whole business, or perhaps a whole industry or economy. Applied to entrepreneurship, we might be able to see that the normal unit of analysis is that of the organization that is trying to bring a new product or service to market. Occasionally, this whole might be within the context of an industry and considering the competitive positioning of a new offering and how this might create a product–customer fit.

Applying a more holistic perspective to entrepreneurship might mean seeing the role of a new venture in relation to value networks, at the level of societal impacts, or the roles that the introduction of the new firm has on its environment. These perspectives have already become part of the wider narratives of social entrepreneurship, but are somewhat underrepresented in mainstream entrepreneurship literature. For example, a review of 'Disciplined Entrepreneurship' [39], one of the leading textbooks on entrepreneurship, does not comment on the wider effects of a venture's sustainability or impacts on the environment. Lean Startup only mentions sustainability in the sense of an ever-growing business [40], and the same is true for some other well-known entrepreneurship books, such as the Startup Owner's Manual [41].

4.2. Linear vs. Circular—Focus on Feedback Loops and Reinforcing Nature, Not Just Linear Cause and Effect

Systems thinking has a large focus on feedback loops, reinforcing structures, and thinking about second-, third-, and fourth-order consequences of actions [5]. In this sense, it takes a longer-form perspective and considers how actions will play out over time.

This particular perspective has somewhat of a foothold in entrepreneurship already, however generally from a monopolistic perspective. Examples include the idea of a

flywheel as described by Jim Collins, whereby a competitive advantage is gained through creating a self-reinforcing system that builds momentum over time and makes it virtually impossible for your competitors to catch up with you [42]. Alternatively, it is sometimes used in the sense of generating viral momentum through marketing a new venture by ensuring the lifetime value of a customer exceeds the cost of acquiring new customers [39]. In digital industries, the circular nature might be associated with stickiness and attention management, whereby product offerings are designed to retain users and keep them coming back for more (even if this is to the detriment of the customer).

Applying the systems tool in a more constructive way, from the viewpoint of external stakeholders, we could begin to introduce the idea of paying attention to the second-, third-, and fourth- order consequences of ventures and their offerings, in turn encouraging entrepreneurs to think in a wider timeframe that expands beyond sales for the quarter. A well-known negative approach is designing for obsolescence, whereby Apple and Samsung have been prosecuted for designing their phones to be obsolete faster than what they might have otherwise been [43]. This is profitable for the company, but given the raw materials required for the phone, there are few external stakeholders who would think of this as a positive outcome.

Instead, we can encourage entrepreneurs to think about how they integrate their products and services into a more circular offer. Additionally, we might be able to think about encouraging entrepreneurs to design their business models to have positive outcomes on external holders. Again, this has gained some traction in social entrepreneurship [33], but is still far from being normal in mainstream entrepreneurship. In mainstream literature, there is reference to the lifetime value of a customer [39], yet no reference to the lifetime impact of products and services on the environment. We could begin to encourage entrepreneurs to think of the cost of production and disposal on the environment, and not have them just consider the financial costs of production.

4.3. Silos vs. Emergence—Results Emerge from Complex Interrelationships

Complex systems are those that are beyond being able to be analyzed, and therefore are best understood through seeing the patterns that emerge over time [44]. Emergence is the concept that the results of a system emerge from the individual parts of a system, and the interaction that they have with one another. The concept of emergence has a space within the entrepreneurship community already and is the philosophical basis for effectuation [45]—a key theory in the field of entrepreneurship. It says that ventures cannot always be planned for, but rather are the result of differing resources and actors being combined, and with new ventures emerging out of this complex interaction [46].

The normative implication of this is that we cannot always plan our way to a new venture, but rather through making concerted efforts, a new venture can emerge. Additionally, a crucial concept of emergence is that small points of leverage can have big impacts on the final emergent outcome. As such, we need to begin to encourage entrepreneurs to think about the leverage points in their own ventures that can result in a more positive economic system, and combined with the earlier points have them see that their venture is not a singular economic unit, but is part of a bigger whole, and the creation of a new venture can have long term implications for society.

4.4. Parts vs. Whole

A downside of the analytic approach is that we tend to focus on the individual elements. Systems thinking encourages a focus on the whole, and is sometimes explained with the memorable analogy that two halves of a horse are not the same as a horse [11].

In entrepreneurship, we have seen this be applied in the form of 'customer journey mapping' and 'customer lifecycle analysis', where it is not just the purchase transaction that forms the focus, but the entire value offering to the customer [47]. Yet, this lifecycle analysis does not normally take into account disposal of products or environmental externalities of the products sold by a venture. As such, we could encourage nascent entrepreneurs to

think more holistically about their value offering. We could encourage them to see that their organization is not a single unit, but to view themselves as a part of a whole network of actors, whose individual actions collectively have large and important impacts.

4.5. Analysis versus Synthesis—The Idea of Synthesis Is the Creation of Something New through the Combination of Existing Elements

In its nature, entrepreneurship is synthetic. It focuses on building ventures through the combinations of resources, with the goal being to create something new out of component parts. Synthesis is the lens through which effectuation and design thinking explain how individuals can create ventures.

What is less discussed is the idea of what entrepreneurs 'should be' synthesizing. The underlying (hidden) mental model is that they should be creating business models that focus on value creation for themselves and shareholders. If we shift the focus of entrepreneurs towards synthesizing firms with a broader perspective and a realization that they are part of a whole, then we can begin to shift their mindset towards having an overall more positive impact.

4.6. Isolation vs. Relationships—Not about the Individual Elements, but Paying Attention to Interrelationships

Systems thinking conveys that it is not the individual elements that matter, but rather the relationship between them that should be of crucial importance [5]. If we apply this to the context of entrepreneurship, we can begin to re-imagine what an economic business model might look like. Instead of the traditional competitive perspective, where there is a race to create a competitive advantage and beat your competition, we focus on more co-opetition or complimentary business models [48]. In particular, we could have students reimagine what the role of a company is in facilitating positive outcomes for society, so that entrepreneurship could be more focused on creating value networks or clusters of value in small economic micro-systems.

This might sound naive or overly simplistic, however, there is a growing pressure on ventures to find ways to continue to survive in a world of hypercompetition [7,36]. Indeed, evidence suggest that across the board, most firms are finding it harder to maintain an economically sustainable model, and that creative destruction is speeding up the process in which firms are replaced by new entries [7]. Noting that traditional monopolists have been able to maintain their monopolies where is it is uneconomic to build new infrastructures can be seen as aspirational. Perhaps the sustainable economic infrastructures of the future are those value networks that, due to their systemic conceptualization and co-location, have a collective competitive advantage that cannot be easily replicated.

Indeed, this is one of the key features of our case that we will now shift our focus toward discussing in order to show how these six systems perspectives can be actively applied to an entrepreneurial class.

5. Sparking Change in the Next Generation of (Systems?) Entrepreneurs

One of the challenges mentioned so far is that the global economic system of today has reached a status quo that, while obviously problematic, seems unlikely to change of its own free will due to the complex mix of stakeholders and power dynamics. This might seem an uninspiring starting point, but Meadows [12] provides some guidance on where best to intervene in such a system. She highlights 12 points, with the most crucial being that of transcending paradigms. This is a lofty goal, but given the alternative of continued planetary destruction, we suggest it is worth striving for.

However, a more attainable place to begin is at the second most powerful leverage point inside a system, and that is with shifting mindsets of those operating in the system. Meadows points out that change may be brought about by consistently and repeatedly pointing out the failures and assumptions of existing systems to those with an open mind. She discusses the needs to shift social paradigms through questioning assumptions and resetting these collective assumptions into a new socially accepted paradigm.

Education would appear to be a location where mindsets and collective paradigms can be shifted amongst young people with open minds [49]. It seems therefore fitting to focus on education as a tool through which we can begin to implement the leverage suggested by Meadows. A lot has been written in the field of entrepreneurship about shifting mindsets [50–53] and creating entrepreneurial mindsets [50,54–56]. While the exact definition of an entrepreneurial mindset is under debate [51], there is nothing that precludes nudging students towards having a broader environmental perspective when thinking of venture creation. Indeed, the original definition of 'mindset' was described as individuals having their mind set on finding solutions to the challenge at hand [55].

If students are tasked with creating entrepreneurial ventures that take into account a broader system picture, then their mental models will likely have this as a new baseline when they consider entrepreneurship in the future. In order to demonstrate the way students can be encouraged to have this wider perspective, we now turn to a case study.

6. Case Context

To illustrate the use of entrepreneurship from a systems point of view, we choose to highlight one possible method for communicating how to shift students' mindsets to take a more holistic viewpoint. The case is not intended to suggest that this is the best approach to teaching a systems perspective in conjunction with entrepreneurship, but rather one way that appears to have impacted students' awareness of the complexity of entrepreneurship and was experienced as a valuable learning experience for those involved.

Case studies are recognized as a relevant real-world research design [57] and are especially relevant for producing contextual knowledge [58] for maneuvering within complex processes [59,60]. Case studies are also appropriate for contemporary and emergent phenomena in a real-world context, including real-time and retrospect data [61,62].

The case relates to a corporate challenge, whereby a local land developer contacted our University College to inform us that they were planning to build a new business park. The corner stone tenant of this development was to be a giant datacenter. A common issue with datacenters is that the servers inside them need to be cooled in order to operate efficiently, as a result there is excess heat energy that needs to be removed from the datacenter and is commonly just extracted into the local environment in the form of warm air via air conditioning [63]. According to the information provided by the developer, it was expected that 40 megawatts (MW) of excess energy would be expelled into the air each year. The developer was concerned about the impact on the local environment as well as feeling like this heat would be wasted if it was just dispersed into the atmosphere. To put the figure into perspective, an average home in Norway uses 16,000 kilowatt-hours (kWh) (https://energifaktanorge.no/en/norsk-energibruk/energibruken-i-ulike-sektorer/ (accessed on 27 April 2021)), meaning the excess waste from the datacenter would be equivalent to the power usage of 2500 homes.

From an economic perspective, the development of the datacenter was profitable based on current economic conditions regardless of what happened with this excess heat. However, the developer pointed out that this heat seemed like an underutilized resource and was curious whether there was an opportunity to find a potential upside. In an initial meeting, we decided to see if we could use first year bachelor students to find potential opportunities for this heat resource. From a technical perspective, there is a clear solution as to how to use the heat, so the challenge is not one of technology. The heat can easily be transferred out of the datacenter via water cooling systems, and used to heat nearby homes and businesses. There are multiple examples of such solutions in the region. However, the heat in this case went far beyond what any nearby businesses would need in regards to normal heating. The distance between the business park and any nearby housing meant that building a pipeline to transfer the warm water was instantly ruled uneconomic due to the costs and time involved in negotiating with landowners whose land the pipe would traverse. The challenge then became what to do with the heat within the confines of the business park.

7. Application in a Teaching Setting

In order to address the challenge from the corporate partner, we decided to have all 52 students from a compulsory first year course in a bachelors level program address the challenge towards the end of their first semester. The students study a program called innovation and project leadership, which is a three-year Bachelor's focused on experiential learning through running a number of projects, including starting businesses, building bridges, organizing wilderness experiences, and providing innovation consultancy services to businesses to name a few of the projects. The program allows a degree of freedom for students to steer their own learning through choosing which particular projects they work on. As the students were approaching the end of their first semester, they had been introduced to a number of theories or schools of thought, and had applied these in varying degrees to small week-long projects. These schools of thought included circular economy, biomimicry, entrepreneurship, and design thinking. The theory associated with each of these schools of thought was introductory in nature and had not been taught in-depth to students.

As part of the challenge, students were aquatinted with the basic theories of entrepreneurship around business models, customer's needs, and finding a problem–solution fit [39,47,64,65]. In addition, students were invited to three question and answer sessions lasting approximately 2 h, each with knowledgeable individuals from differing fields, such as a local expert on water heat exchangers, another on renewable energy and innovation, and the developer running the project. The introduction to these differing perspectives helped shape students' perspectives on how to think about the task at hand.

In addition, daily coaching sessions were held with each of the eight teams working on the challenge. Students were allowed to choose their teams, and all teams had a mix of genders. These coaching sessions allowed the teacher (one of the authors) to steer the direction students were heading in, although the students retained a great deal of freedom to solve the challenge in a way they thought suitable. The teacher aimed to have students avoid any technical type approach (i.e., focusing on the particulars of how heat would be transferred) and instead had students focus on 'who' needed the heat, which types of businesses required the type of excess heat the datacenter would generate, and what were the requirements of this heat (such as consistency, timing, peak loads, etc).

8. Student Approach and Results

The students had no prior technical knowledge of the area of heat-recirculation, requiring them to go out and discuss the idea with a large number of companies to better understand the commercial needs of businesses. In some instances, students visited companies to receive tours and discuss with the companies' engineers the technical requirements the production facilities needed. They also discussed with the financial officers and CEOs the needs of the business to gain greater insights into whether there was a fit between the waste heat from the datacenter and what the individual companies needed.

The students worked in groups of four to six people on the challenge for 10 days before having to present their ideas to the developer. The developer stated after the student presentations that 'they were impressed by the suggestions of the students and that the work by the students went well beyond what was expected from them'. The developer then decided to initiate a longer-term collaboration with students on the project, which we do not discuss in detail here. The students provided the developer with a two-page summary of their findings, including further leads for the developer to follow up with regards to individual companies and types of industry players who might need this type of heat in their production process.

To draw on an example, one group visited a paper production facility and discovered that the facility needed around 14 MW of steam production each year. As part of this production, the paper company was paying USD 4.1 M per year in gas, USD 410,000 in carbon credits, and USD 3.4 m in electricity. The company did not reveal which percentage of the electricity bill was related to steam production, but the carbon credits and gas

were almost entirely related to steam production, with electricity being used instead of gas when spot prices made it more economical. The students were thus able to identify paper production as a key industry that could benefit greatly from co-locating beside the datacenter. While the particular company the students visited did not express a willingness to move, having recently refurnished their plant, the business case for such a location was clear. This allowed students to begin to narrow their search to other paper production companies who might be willing to shift location. The business case was that the reduction in the cost of gas and carbon credits would be shared equally between the data center and the paper production company, with the commercial upside for the developers being that they could demand a greater price for their land given the benefit of locating there, and as well as being able to use positive publicity around the project to increase their profile.

A separate team focused on a more circular economy perspective, aiming to find a wider range of commercial players for whom waste heat energy might be of use. They identified as examples shrimp farming, algae growth, greenhouses, and insect production as types of commercial players who if co-located together could benefit from synergies associated with each other. The perspective focused on creating a value cluster that also made use of other infrastructure such as roading networks and being relatively closely located to major food distribution centers.

Neither idea is revolutionarily innovative, or might not even be considered innovative at all given that none of the ideas were new industries. Instead, the focus was a more systemic view of how businesses could cross-benefit from each other's waste products and create shared value through a non-traditional business model. These have not traditionally been the key focus areas of entrepreneurship education. Traditionally, education has focused on using resources to produce something new, and often in the process creating additional waste and pollution [2]. In this instance, the focus for the student groups was about using the resources currently available (or planned to be available) and finding a way to ensure that they were used instead of simply being wasted. Yet, this requires a reconfiguration in the way business is normally organized.

9. Discussion: A Systemic Approach to Entrepreneurship

We do not mean to argue that this case highlights the best way of teaching entrepreneurship and system thinking together. We do not even argue that this way is better than teaching the two subjects separately. Instead, we mean to highlight that it is possible to have students shift their mindset relatively early on in their education to have them consider a wider perspective that goes beyond narrow economic gain often associated with capitalism and entrepreneurship [13,14]. None of the students presented a case that focused on solely maximizing the developers profit. Rather, they had their focus on generating value across multiple business organizations. This represents a shift in mindset from singular optimization of an individual organizations profit to a focus on optimization of a cluster/network of organizations in order to maximize the system as a whole [48]. This represents a clear difference from discussions around sustainable entrepreneurship to date [66], which focus on improving the environmental outcomes of individual organizations (and/or their supply chains). In including systems thinking theory, we saw students' perspectives widen in number of ways, as discussed below.

9.1. Disconnected vs. Interconnectedness

The students were able to see that there was a valuable resource (heat) that could be shared across multiple business organizations. Instead of engaging in typical business development focused on the profit maximization of a single entity, they were able to shift their focus or analysis to the interconnectedness of businesses that could be co-located together in order to create value that was relevant for a cluster of companies.

They were also able to see the interconnectedness of a single business activity with downstream consequences, and to design solutions that minimized the impact on the surrounding environment. Viewing the interconnectedness of the business with the sur-

rounding environment, and the potential for negative consequences, allowed them to see the need for a shift in existing ways of carrying out business and that the single metric of profit was problematic.

They were also able to see their own interconnectedness to the project and that they had the power to influence the final outcomes of the development that was to occur in their local environment. They therefore went from seeing themselves as passive observers to seeing the agency they had to push the project to head in a direction they considered positive.

9.2. Linear vs. Circular

Students became aware of the nature of feedback loops; for example, the developer expressed concern that if cold air was to be used to cool the datacenter, then the warm air that was expelled might potentially reduce the snowfall in the area (an unpopular outcome in a ski-obsessed nation), which would further lead to warming in the area (as snow reflects thermal heat), and that this feedback loop could have negative consequences with regard to ski conditions.

Students also saw how the 'process' of producing profit does not stop once something has been sold, and that there are downstream consequences that could be used in a constructive manner to design a more circular-based economic model. They, for example, were able to see the possibility that existed to use the waste heat to warm water for shrimp farming; the waste from shrimp farming could then be used for fertilizer, with the additional heat also being used for greenhouses, with the organic rubbish from the greenhouses being able to be used for feeding insects that could eventually be fed back to the shrimp. They could then see the second- and third-order consequences of setting up a synergistic value network of businesses.

9.3. Silos vs. Emergence

Students were able to gain experience with emergence as a concept connected to entrepreneurship, whereby a path became clear as they took action, which opened further possibilities and understanding of the situation in which they were trying to create value. In addition, they were able to experience emergence in the design of a business system [13].

In the beginning, many of the students were uncertain of how to proceed and felt insecure about their ability to come up with a solution. They were guided through a process with strong roots in emergence and sharing pedagogical roots with design thinking that pushed them to speak with potential relevant stakeholders, seek information, and create their own questions and sources of answers. In doing so, they experienced the emergence of their own understanding and with it the emergence of solutions and paths forward. A critical philosophical point of emergence is that small changes in starting factors can lead to extremely different outcomes in end scenarios. In this sense, they were able to see that their own small interactions in projects could play a large role in determining the outcomes in their local environment.

9.4. Parts vs. Whole

In a traditional sense, a business case involving a datacenter would focus on profit and only profit. This case allowed students to see that there was much more involved in developing a business park involving a datacenter. They were much more able to see the whole picture and how the different parts hung together. The typical example of two halves of a horse not being the same as a horse applies here too; they were able to see that half of a development of just building a profitable datacenter missed the opportunity to build the other half of the horse, which could be interconnecting businesses leading to a reduction in power (measured across all businesses), a reduction in Co2, and saved costs with regards to carbon credits. They could see this whole and how creating this whole was far more valuable than focusing on singular parts of the value chain.

9.5. Analysis versus Synthesis—The Idea of Synthesis Is the Creation of Something New through the Combination of Existing Elements

The project had strong synthetic elements to it; there was previously no value cluster and there were no plans to create one either. The students were then compelled to use the resources they had, such as their own knowledge, the knowledge of others, and their networks, to begin to generate interest from different stakeholders. In doing so, they carried out a process strongly resembling effectuation [45].

9.6. Isolation vs. Relationships—Not about the Individual Elements, but Paying Attention to Interrelationships

This case was a clear example of how to have students shift their mindset towards focusing on the relationship between business organizations in an attempt to create mutual value. The flow of resources between the planned businesses was the key theme for the project, and a crucial part was having students understand the nuances of these relationships as well. For example, students had to research the peak flows of heat in the datacenter compared to the timing of needs in the other organizations. It was important to understand the timing and needs of each business process and how these could be interlinked.

Another example, an initial idea that was later discarded by students, was the use of the datacenter heat to dry corn. While corn farmers use a lot of heat, they only need this in a single month of a year, meaning using the heat for such a short period did not make sense. Yet, another idea discarded early was the use of the heat to generate steam, run engines, and recycle this energy back into electricity. However, it showed that the heat from the data center was not suitable for this kind of steam generation. In this sense, students focused on the relationships and demands between the individual elements in their quest for creating solutions.

9.7. Differing from Sustainable Entrepreneurship

One particular criticism that might be levelled at the suggestion of blending entrepreneurship and systems thinking is the question of how is this different from existing fields such as sustainable entrepreneurship or social entrepreneurship, where the focus is on having a 'green' approach to business. We would argue that there is a significant and important difference. Sustainable entrepreneurship is still focused on singular entities and trying to reduce their particular negative impact. It is still analytic/linear in nature and often has a more incremental starting point. We do not mean that as criticism, and think sustainable entrepreneurship has a valuable place within a transition to a more sustainable future.

However, combining systems thinking with entrepreneurship is different, as it is less about individual entities and instead focuses on the creation of value and the use of resources in a more systemic way, that is, the creation of value clusters, for example, the design of the interaction between these individual organizations in which the value creation is intended to be maximized across the group, and in which value can also include the reuse of resources or the reduction of waste. In this sense, it moves away from viewing organizations as silos and instead views their individual value creation within a larger system and context, and in this sense aims at removing a kind of systems blindness that can account for the current negative business practices.

9.8. Shifting Mindsets

The original idea of mindset relates back to the work of cognitive psychologists in the early 20th century at the Würzberg School of Cognitive Psychology [67], where 'mindset' was a term used to describe on an individual setting their mind on finding a solution to a particular challenge. We can consider the goal here to shift students towards having their mind set on using a systemic perspective when engaging in entrepreneurial behavior with the desired outcome being a more sustainable set of business outcomes. Examining whether there is evidence that mindset shifts have occurred would require an in-depth

study of students' perspectives before and after. We accept that this particular study is explorative in nature and does not reach the standard of being causative evidence of a mindset shift. The intention behind the case is to demonstrate that there is a coherent way that these three areas can be taught together in order to connect systems thinking, sustainability, and entrepreneurship.

Based on the observed work of the students and their deliveries, it would appear that there is ample evidence that they were able to manage the existing tensions between these three theoretical perspectives and find resolutions that might have been suboptimal for any one organization, but were optimal when considered holistically across multiple organizations. In this sense, students were able to shift their mindsets toward having agency in creating outcomes that impacted their local environment. As mindsets can be shaped through education, we hope this formative education experience helped students to have a mindset that was more sustainable while acknowledging the important roles that setting up commercial systems can have in benefitting everyone.

10. Going Forward

We have only begun to explore the concept here of joining the fields of systems thinking and entrepreneurship. Given this is a new perspective, it likely lacks nuance and therefore requires further exploration. As a single case study, this is intended only to begin exploring the overlap between the two fields and how it might be taught. We would welcome much more rigorous approaches to examining the ability of teaching to shift students' mindsets in a way that they begin to consider the holistic picture. We suggest a fruitful path for further research would be to examine students' reflections on their experiences of learning in this manner, and to begin to examine whether a shift in mindset has occurred.

In addition, the goal of shifting mindsets around how to begin to tackle global systemic challenges is obviously a daunting and ambitious task, but all movements start with minor steps. We encourage further exploration of this topic in order to examine the topic with greater rigor.

11. Caution in Systems Thinking

We advocate for developing a sense of agency in students so as to empower them to make what they consider to be positive changes in their environments. At the same time, influencing systems needs to be approached with a genuine sense of caution. As even the earliest systems thinkers pointed out, issues of social systems are incredibly complex and go far beyond individuals' capacity to analyze their way toward a solution [21].

Going a step further, there has been a great deal of harm done by what has been labeled 'naïve interventionalism' [20], where the intention to do good was clear, but the result was the opposite of that intended. As Meadows points out, people often know intuitively where leverage points are; however, they have a tendency to pull in the wrong direction [12]. We therefore reiterate the need for caution in encouraging students to begin to experiment with systems change, and they should be made equally aware that not all problems have a 'technical solution' and will therefore require trade-offs that enter into the realm of ethics and competing moral values [68]. As the age of the citations in this subsection testify, these are not new issues, but still ones we need to be cognizant of as we continue to wrestle with how to move society forward in a desired direction.

12. Conclusions

The article starts from the assumption that the current economic systems are creating a number of problems that are systemic in nature, and therefore require systemic solutions. Traditionally, entrepreneurs have played a crucial role in the shaping of systems and markets, but the current mental models of entrepreneurship are flawed in that they teach students to focus on wealth maximization (often at the expense of stakeholders and the environment), which leads to suboptimal solutions at a systems level.

Based on prior literature, we argued that one of the best ways to change a system is to shift the underlying mindsets or mental models of those inside it. We therefore argued that education should place greater focus on viewing the 'wholeness' of environmental and economic systems when engaging in entrepreneurship. In order to demonstrate how this can be done, we highlighted the theoretical arguments with a case study to demonstrate how entrepreneurship could be taught with a greater focus on seeing the 'wholeness' of the situation and not focusing on value creation at the individual organizational level.

There is still a lot of work to be done in order to more elegantly connect the fields of entrepreneurship and systems thinking if more students are to produce sustainable economic systems, and more work needs to be done to shift the mindsets of students interested in these fields. This article aims to take an early step toward achieving both of these, and we welcome and hope for further contributions from the field in this area. Potentially fruitful areas for further research would focus more on examining whether shifts in mindsets do occur from such teaching and whether this influences entrepreneurs' ventures when they finish their education. In addition, there are likely contributions to be made with regard to clarifying the theoretical overlap and contradictions between the fields.

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