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Article

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Journal of Business Models (JOBM)

Provided in Cooperation with:

Aalborg University, Aalborg

Suggested Citation: Bitetti, Leandro; Bedolla, Mattia (2024) : How (sustainable) business model patterns help initiating design for sustainability, Journal of Business Models (JOBM), ISSN 2246-2465, Aalborg University Open Publishing, Aalborg, Vol. 12, Iss. 1, pp. 133-146, <https://doi.org/10.54337/jbm.v12i1.8410>

This Version is available at:

<https://hdl.handle.net/10419/319029>

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JOURNAL OF BUSINESS MODELS

How (Sustainable) Business Model Patterns Help Initiating Design for Sustainability

Leandro Bitetti^{1,*}, and Mattia Bedolla²

Abstract

This study explores the cognitive impact of sustainable business model patterns on initiating design for sustainability, comparing them to traditional patterns. Utilizing a quasi-experimental design with four teams of Master's students in Innovation Management, we assessed how the type of business model pattern cards influences cognitive processes and idea generation during ideation. Our findings demonstrate that sustainable business model patterns significantly enhance cognitive stimulation, promoting a broader perspective on sustainability issues. They excel in integrating all three dimensions—economic, ecological, and social—of sustainable business model innovation within the context of idea generation. This research bridges interpretations of business models as (1) cognitive schemas and (2) formal representations, highlighting the pivotal role of specific visual tools in facilitating sustainable business model innovation. This includes challenging cognitive barriers and fostering a comprehensive approach to sustainable design.

Introduction

Sustainable business model innovation, which refers to the design or the adaptation of a financially viable business model that creates economic, social, and environmental value (Bocken *et al.*, 2016; Schaltegger *et al.*, 2016; Stubbs and Cocklin, 2008), has become a hot topic for both practitioners and scholars

(Andersen *et al.*, 2022; Filser *et al.*, 2021; He and Ortiz, 2021; Laukkanen and Patala, 2014). In fact, incumbent firms are increasingly called to reconfigure their existing business models in order to address sustainability challenges (Frishammar and Parida, 2019; Snihur and Bocken, 2022; Stål *et al.*, 2022). This falls under the umbrella of design for sustainability, which

Keywords: sustainable business model innovation; business model patterns; cognition

Please cite this paper as: Bitetti, L., and Bedolla, M. (2024), How (Sustainable) Business Model Patterns Help Initiating Design for Sustainability, Journal of Business Models, Vol. 12, No. 1, pp. 133–146

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is an emerging discipline that aims to integrate sustainability considerations into the design process in order to promote environmentally responsible and socially equitable outcomes (Rocha *et al.*, 2019). Design for sustainability has evolved from a focus on product design to a broader view of system innovation and transitions (Ceschin and Gaziulusoy, 2016). Initially, the focus was on reducing the environmental impact of products through eco-design strategies such as material selection, energy efficiency, and recyclability (Boström, 2012). Later, design for sustainability expanded to address social and economic dimensions, including issues such as labor rights, social justice, and economic viability. More recently, design for sustainability has shifted towards a systemic perspective that seeks to address complex problems by integrating multiple actors, technologies, and policies (Ceschin and Gaziulusoy, 2016). However, we know from the extant literature on business model reconfiguration that cognitive barriers such as the dominant logic (Prahalad and Bettis, 1986) and path dependence (Sydow *et al.*, 2009) make business model innovation particularly difficult even to ideate (Frankenberger *et al.*, 2013; Laudien and Daxböck, 2017; Täuscher and Abdelkafi, 2017). This is particularly significant with sustainable business model innovations because of many reasons as their multi-stakeholder perspective, lower profitability in the short term, and the difficulty to achieve financial, social, and environmental metrics (Bocken and Geradts, 2020; Cederholm Björklund, 2018; Geissdoerfer *et al.*, 2018; Guldmann and Huulgaard, 2020; Matos and Silvestre, 2013). To overcome these challenges, the extant literature shows that cognitive dynamic capabilities may assist entrepreneurs and managers in the reconfiguration of business models (Bitetti and Gibbert, 2022; Helfat and Peteraf, 2015; Santa-Maria *et al.*, 2022; Wójcik and Ciszewska-Mlinarič, 2021). In addition, visual tools and formal representations of business models may stimulate cognition to enable business model reconfiguration (Täuscher and Abdelkafi, 2017). This has been studied also in the field of sustainable business model innovation. Lüdeke-Freund (2011) developed a generic template for 'Business Models for Sustainability', which identifies the key elements of a sustainable business model, including a description of the value proposition, market segment, revenue model, cost structure, social impact, and

environmental impact. Similarly, Joyce and Paquin (2016) developed the triple-layered business model canvas, which is a tool with three layers: (1) the business model layer, which defines the organization's value proposition, customers, revenue streams, and costs as the original Business Model Canvas (Osterwalder and Pigneur, 2010); (2) the social layer, which defines the organization's impact on society; and (3) the environmental layer, which defines the organization's impact on the natural environment. These templates can be used to analyze and design sustainable business models in different contexts. Another important enabler for business model innovation ideaation are business model patterns and archetypes. Gassmann *et al.* (2013) discovered that most innovative business models are a reconfiguration of existing business model patterns from other industries. This process resulted in the creation of 55 business model patterns (Gassmann *et al.*, 2016). On the other hand, a literature and practice review by Bocken *et al.* (2014) developed a set of sustainable business model archetypes that can be used as a basis for designing new sustainable business models. The archetypes include the circular, performance-based, sharing, product-service system, and sufficiency models. Departing from these two studies, Lüdeke-Freund *et al.* (2018) involved groups of experts to determine 45 patterns for sustainability-oriented business model innovation. This study precedes the development of a book on sustainable business model design, around the 45 patterns determined (Lüdeke-Freund *et al.*, 2022). Sustainable business model patterns, in contrast to conventional patterns, are strategically tailored to address persistent challenges that hinder businesses from effectively creating value that is ecologically, socially, and economically viable (Lüdeke-Freund *et al.*, 2022). Sustainable business model patterns, much like their traditional counterparts, share a common application in the initial ideation stage of business model innovation (Gassmann *et al.*, 2016; Lüdeke-Freund *et al.*, 2022). The ideation phase poses inherent cognitive challenges, further complicated by the imperative to comprehensively incorporate sustainability dimensions from the outset (Cederholm Björklund, 2018; Frankenberger *et al.*, 2013; Guldmann and Huulgaard, 2020; Laudien and Daxböck, 2017; Täuscher and Abdelkafi, 2017). Moreover, sustainability, though inherently value-adding, can potentially introduce

substantial cognitive constraints during the early design stages (Maccioni et al., 2017). In the current landscape, managers and entrepreneurs possess diverse tools for crafting sustainable business models; however, limited empirical exploration exists regarding the efficacy of sustainable business model patterns as compared to conventional counterparts in facilitating the ideation of sustainable business models. The question of whether sustainable business model patterns (Lüdeke-Freund et al., 2022) offer distinct impacts relative to traditional business model patterns (Gassmann et al., 2016) on cognitive processes and idea generation within the ideation phase of business model innovation remains unanswered. This prompts us to pose the following research question: *"How do sustainable rather than traditional business model patterns influence cognitive processes and idea generation during the ideation phase of business model innovation?"*.

To tackle this research question, we adopted a dual interpretation of business models according to Massa et al. (2017): firstly, we consider business model as cognitive schemas as we study how dominant logics may be overcome by pattern cards; secondly, at the same time we also interpret business model as formal, conceptual representations of how businesses create and capture value, as we apply business model pattern cards and business model representations in the design process. Therefore, we aim at contributing these two interpretations in conjunction, highlighting how sustainable rather than traditional business model pattern cards cognitively stimulate the ideation of sustainable business models.

The remainder of the article illustrates our methodological approach to answer our research question, the findings of the intervention made, and some discussion to highlight our contribution to the literature, as well as some practical implications, study limitations, and some suggestion for further research.

Methodological Approach

The current study used a quasi-experimental design with an intervention in a classroom setting to

investigate the impact of utilizing different types of business model pattern cards on the ideation process for sustainable business model innovation. The intervention aimed to assess the impact of employing distinct business model pattern cards—namely, sustainable versus traditional—within the innovation process. The research intervention encompassed two distinct groups: Group A (Control), which received traditional paper-based business model pattern cards, and Group B (Treatment), which received sustainable business model pattern cards in the form of an e-book. This divergence was due to the lack of paper-based sustainable business model pattern cards at the time of the experiment. This experimental setup aimed to scrutinize the differential impacts of these business model patterns on the cognitive processes and idea generation essential to the ideation of sustainable business model innovations tailored for Netflix. The participants consisted of Master students in Innovation Management from a single university. Four teams, each comprising 5 to 6 students, were formed during a lecture within the "Business Model Innovation Strategy and Mindset" module. The module aims at providing the tools and the mindset that strategists need to use to assess and reconfigure business models to meet stakeholders' needs, as the world is increasingly volatile, uncertain, complex, and ambiguous, and innovation managers need to rethink their existing business models to compete successfully and by creating sustainable (economically, environmentally, and socially) value. Participants were randomly assigned to either Group A (Control) or Group B (Treatment). Each group contained two teams. The team members assigned warrants for similarity across groups, as they were distributed to form highly heterogeneous teams by varying educational background, age, nationality, gender, working experience, and use of Netflix. Group A and Group B were placed in different rooms. During the experiment, teams were led to believe that the primary objective was to compare the effectiveness of paper-based versus digital (e-book) pattern cards in business model innovation. This deception was designed to prevent participants from realizing the actual comparison involving the types of pattern cards. Both groups were presented with the task of reconfiguring a sustainable business model for Netflix, utilizing the Business

Model Canvas as a guide. This challenge was chosen because the firm was familiar to the participants and they had theoretical knowledge of the business model innovation process. No specific restrictions on the number of cards to be used were imposed, and participants were encouraged to navigate the cards freely to stimulate creative thinking. We presented the challenge simultaneously, with one researcher in one room, and the other researcher in the other room. We presented the challenge using the same words and examples, by explaining how to solve the challenge. We highlighted that the participants received the Business Model Canvas representing Netflix's business model and that they needed to reconfigure it by ideating a more sustainable business model, by taking inspiration by business model patterns. Business model patterns was a new topic for the participants. We made an example during our explanation, by telling them that, for example, they might find a pattern called "freemium", that indicates a business model that discriminates among target groups, and there is a customer segment that does not pay for the product, and another target group that subsidizes the other by paying. The description was intentionally vague as the different card sets had different descriptions, as the sustainable business model patterns present a 'social freemium'. Each team was granted 90 minutes to ideate their sustainable business model reconfiguration. After the challenge, teams presented their solutions to the class, with the presentations recorded for subsequent analysis.

The data collection process also included diary notes detailing the ideation process and reasoning, as well as post-intervention semi-structured interviews conducted with participants. A total of 8 semi-structured interviews were conducted with participants after the intervention. We interviewed 2 students of each team. These interviews were aimed at understanding participants' perspectives on (1) the problem identified for Netflix and how it evolved during the experiment (i.e., cognitive processes), and (2) the rationale underlying their selection of specific business model patterns as solutions (i.e., idea generation). Particularly, we delved deeply into group reasoning, elucidating cognitive

processes encompassing the evolution of perception about Netflix's business model throughout the experiment. Furthermore, we probed the idea generation process, exploring how participants conceptualized sustainable business model innovation. Each interview lasted approximately 30 minutes on average. The interviews were conducted by the first author of the present paper and a guiding protocol was established to facilitate consistent data collection. The protocol encompassed areas such as the problem perception, rationale behind chosen solutions with emphasis on applied business model patterns, and the dominant dimension (environmental, social, economic) in their proposed reconfigurations.

The data collected from the study was analyzed quantitatively and qualitatively. A qualitative study using thematic analysis of post-intervention semi-structured interviews was triangulated with our notes during the process and during the recorded presentations. The recorded presentations were transcribed and analyzed using content analysis to identify themes related to the reasons of the choice made by participants. The quantitative data included the scores assigned by three independent lecturers to each team's business model innovation, based on a set of criteria related to economic, social, and ecological value creation as established by Lüdeke-Freund et al. (2018, 2022).

Key Insights

The outcomes of the study explore the impact of different types of business model pattern cards on cognitive processes and idea generation during the ideation phase of sustainable business model innovation. By interpreting business models through cognitive schemas and employing business model patterns, which highlight the conceptual representation of value creation and capture (Massa et al., 2017), our investigation illuminates two key aspects. The first consists in the overall mental activities that participants engage in during the ideation

phase (i.e., cognitive processes) and in particular how business model pattern cards influenced their mental activities and operations involved in perceiving, understanding, reasoning, and interpreting information. The second, how participants, equipped with pattern cards, systematically developed sustainable business model innovation solutions, considering ecological, social, and economic dimensions (i.e., idea generation).

Cognitive processes

Despite being equipped with different business model patterns, the starting reasoning and cognition of all teams was similar. All teams framed as key sustainability issue of the current business model of Netflix was related to an ecological dimension, and in particular CO₂ emissions and pollution. However, the teams, divided into Group A (control) and Group B (treatment), each exhibited distinct cognitive processes influenced by the pattern cards they were provided. Group A, armed with traditional business model pattern cards, kept the reasoning along the ecological issue. Group B, equipped with sustainable business model pattern cards, experienced a perceptible shift in focus.

In detail, the first team of Group A reasoned only about reducing the CO₂ emissions. In fact, interviews and our observation during the experiment highlighted that traditional pattern cards stimulated the team members to suggest solutions that potentially deal with this issue. For example, the pattern card "Pay per use" stimulated the team to increase the price of the subscription to allow for offsetting CO₂-related consumption. Moreover, we assessed that the "Cross selling" pattern card stimulated the solution of selling an A++ energy class devices to enjoy the Netflix service. The second team of Group A identified a similar ecological challenge, pinpointing data centers' energy consumption as a critical sustainability issue. Upon encountering the "Add-on" pattern card, their attention shifted toward potential supplementary offerings that could curtail data centers' energy use. While the team explored this avenue, a suitable alternative remained elusive. The "Add-on" pattern prompted consideration of implementing a fee to limit content consumption

time, which, according to the participants, was an unexpected direction. Notably, discussions around the "Freemium" business model pattern prompted a re-evaluation of their initial approach. Ultimately, their proposed solution embraced a freemium model, wherein a free version allowed 85 hours of film viewing monthly, excluding autoplay, HD videos, and downloads. The premium version would incur a fee for exceeding these limits. Team members, during the presentation, reasoned that this approach might discourage upgrading, thereby addressing the ecological challenge. Strikingly, their ecological focus was so profound that economic viability was scarcely considered in their decision-making process.

The first team of Group B initiated their exploration from an ecological concern centered around the adverse environmental effects of global travels associated with content creation. However, we assessed that their perspective shifted as they engaged with the "Socio-Economic Empowerment" pattern. This pattern prompted contemplation on global travel as an avenue to foster social value. The team began contemplating the potential for Netflix to harness global travel for social impact, with the realization that a singular focus on the mainstream market could inadvertently sideline local content and erode cultural identity. Consequently, the concept of cultivating a national market that supports cultural associations and local universities emerged as a solution perceived by participants as addressing a more substantial social issue, outweighing their assessment of the pollution problem. The second team of Group B, reflecting concerns about Netflix's sustainability attributed to its digital nature, identified energy consumption as a pivotal challenge. Nonetheless, their perspective underwent a transformation upon encountering the "Buy One, Give One" pattern. This catalyst led to a contemplation of additional challenges inherent in digital platforms, including reduced accessibility in regions with limited internet connectivity and diminished human interaction. Consequently, they embarked on considering the conception of social events integrated with a philanthropic dimension, directing portions of proceeds toward bolstering social sustainability endeavors, particularly for those underserved by the platform due to limited access. This evolution in their

approach transitioned from addressing the initial ecological concern connected to digital platforms to embracing the broader spectrum of social issues associated with digital businesses.

To conclude, results show that conventional business model patterns prompted a cognitive process aimed at devising solutions for the identified ecological-only challenge. In contrast, sustainable business model patterns initiated a cognitive process that extended beyond the ecological issue, prompting participants to consider a broader spectrum of sustainability concerns encompassing social dimensions within the business model.

Idea generation

Our findings provide insights into the process of generating innovative solutions or concepts for sustainable business model innovation, utilizing either traditional or sustainable business model patterns. Moreover, our results indicate that the utilization of traditional or sustainable business model patterns led to distinct outcomes. Specifically, Group A identified solutions primarily affecting economic and ecological value creation, whereas Group B successfully incorporated the social, environmental, and economic dimensions in their proposed business model reconfigurations.

In the first team of Group A, insightful ideas emerged as they engaged with the pattern cards “Pay per use,” “Subscription,” and “Cross selling.” These cards played a pivotal role in shaping their ideation process, leading to the exploration of a subscription-based business model and the replacement of service devices. Through discussions with the participants, it became evident that the “Subscription” card triggered thoughts about potential discounts tailored to specific customer segments, such as students. Moreover, the “Cross selling” card encouraged them to consider partnerships with other digital streaming platforms to expand the range of services offered to users. In interviews, participants shared their perspective on the feasibility of introducing slight price increments to offset CO₂-related consumption. This insight was sparked by their engagement with the “Pay per use” card, indicating that their idea generation was influenced by the

economic and ecological dimensions of sustainability. Additionally, conversations surrounding the use of environmentally friendly A++ energy class devices revealed participants’ enthusiasm for aligning their business model solution with ecological considerations. The card’s suggestion to incentivize device upgrades through discounts was met with enthusiasm, further underlining their focus on sustainability in terms of energy consumption. The second team of Group A, while focusing on current consumption and the ecological impact of data centers, revealed intriguing ideas through their engagement with the “Add-on” and “Pay per use” pattern cards. Interviews unveiled that the team’s thought process was enriched by the idea of creating an ad-hoc subscription that excluded high-energy functions like autoplay and HD videos. This innovative approach was inspired by the cards, emphasizing the economic and ecological facets of sustainable business model innovation. The “Add-on” pattern, suggesting the introduction of extra charges for extended viewing hours beyond the free tier, further demonstrated their deep consideration of economic sustainability. Conversations with participants reiterated the dominance of economic and ecological perspectives in their generated ideas. Notably, interviews provided additional context, showcasing how the pattern cards played a pivotal role in stimulating their idea generation and guiding their focus toward these dimensions of sustainability. These insights align with the evaluation’s robust scores for the economic and ecological elements of sustainable business model innovation, underscoring the participants’ inclination toward these aspects in their ideation process. Indeed, experts assigned an average score of 3.66 out of 5 to the economic dimension, a mean of 4 out of 5 to the ecological aspect, and an average score of 1.33 out of 5 for the social dimension.

Teams within Group B, equipped with sustainable business model pattern cards, brought forth a unique outcome during the ideation process. The solutions they formulated reflected a comprehensive integration of social value creation, a distinct departure from their counterparts in Group A. Their ideation was significantly influenced by the sustainable pattern cards, guiding their idea generation toward considering a broader spectrum of sustainability

aspects. Notably, interviews highlighted how the “Socio-Economic Empowerment” card ignited discussions on fostering national market development through support for local cultural institutions and universities. Moreover, their proposition to develop region-specific content for cultural reinforcement underlined their commitment to addressing cultural identity concerns. The exploration of price differentiation for local versus international content demonstrated their cognizance of the intricate interplay between economic and social dimensions. Conversations with the participants revealed that the “CO2 offset through tree planting” idea was born from their engagement with the sustainable pattern cards, emphasizing the ecological and social aspects of sustainability. This proposal showcased a holistic approach to sustainability, intertwining ecological conservation and social responsibility. In a similar vein, the second team’s proposal for a premium subscription targeting companies seeking exclusive content previews exemplified their knack for merging economic considerations with social engagement. The introduction of the offline Netflix advisor role and the concept of organizing social events elucidated their

intention to enhance the value proposition while actively contributing to social sustainability endeavors. Evidently, participants in Group B demonstrated a distinctive and holistic orientation toward sustainable business model innovation. Interviews provided valuable insights into their idea generation, validating the influence of sustainable pattern cards in broadening their solutions beyond ecological concerns. The expert evaluation corroborated these findings, revealing high scores across economic, ecological, and social dimensions, further validating the multifaceted impact of sustainable business model pattern cards on idea generation. Indeed, experts provided an average rating of 4 out of 5 for the economic facet, while the ecological dimension received an average score of 3.66 out of 5. Additionally, the social dimension garnered an average rating of 4 out of 5, as evaluated by the experts.

The following table provides a comprehensive overview of the outcomes observed in Group A and Group B, encapsulating key findings pertaining to cognitive processes, idea generation, and expert ratings on the generated ideas.

Table 1.

	Group A (Control)	Group B (Treatment)
Cognitive Processes	<p>Conventional patterns triggered cognitive processes solely focused on addressing the identified ecological challenge.</p> <p>Representative quotes:</p> <p><i>"These patterns truly had to ignite our creativity in addressing the complex issue of CO2 emissions. Ultimately, we came to the realization that patterns influence the realm of solutions more than that of problems."</i> Participant of Team 1, Group A.</p> <p><i>"Exploring the "Freemium" business model pattern was an eye-opener for us. It really sparked our thinking on how to tackle the ecological challenge head-on. However, as we delved deeper into the discussions and solutions presented by other teams, we realized how easy it is to get caught up in one aspect and unintentionally overlook the broader social and economic issues."</i> Participant of Team 2, Group A.</p>	<p>Sustainable patterns spurred holistic consideration of ecological and social aspects.</p> <p>Representative quotes:</p> <p><i>"Pattern cards illuminated the myriad sustainability challenges inherent in Netflix's business model that had eluded our initial assessment. For instance, when presented with a business model focused on socio-economic empowerment, we were compelled to question whether the existing model truly empowered individuals. This introspection revealed that the current business model might even foster social issues."</i> Participant of Team 1, Group B.</p> <p><i>"Engaging with pattern cards prompted us to transcend the confines of the Netflix-specific case and delve into the broader implications of sustainability within digital business models. The process encouraged us to think beyond immediate concerns and contemplate the intricate web of environmental and social impacts woven by these platforms."</i> Participant of Team 2, Group B.</p>

Table 1: Comparison of the results between Group A (control) and Group B (treatment)

Idea Generation	<p>Prevalence of economic and environmental perspectives in their generated ideas.</p> <p>Representative quotes:</p> <p>"We delved into various patterns, and the process was like a puzzle that helped us piece together effective business solutions for the ecological challenges we identified. It was like having a toolkit to navigate the sustainability landscape. However, we understand that dealing with social issues in the business model should depend on the specific context and whether they are pertinent." Participant of Team 1, Group A.</p> <p>"We were grappling with the challenge of not just making a solution ecological, but also ensuring it made financial sense. It's like finding the sweet spot where sustainability and profitability meet." Participant of Team 2, Group A.</p>	<p>Balanced and comprehensive integration of economic, social, and environmental perspectives in their generated ideas.</p> <p>Representative quotes:</p> <p>"We began exploring business model ideas that considered a mix of ecological, social, and economic factors, as the pattern cards emphasized the significance of addressing all these dimensions. We realize that achieving a perfect balance among these three aspects might be challenging, but it's crucial to take them all into account." Participant of Team 1, Group A.</p> <p>"Our brainstorming led us to solutions that bridge the gap between ecological and social dimensions. The pattern cards emphasized the importance of considering both aspects, and we realized that solutions with a positive ecological impact can also contribute to social well-being. It's about creating a synergy between these dimensions, and the pattern cards guided us in finding those connections." Participant of Team 2, Group B.</p>
Assessment of solutions by experts	<p>Economic (mean: 3.66 out of 5)</p> <p>Ecological (mean: 4 out of 5)</p> <p>Social (mean: 1.33 out of 5)</p>	<p>Economic (mean: 4 out of 5)</p> <p>Ecological (mean: 3.66 out of 5)</p> <p>Social (mean: 4 out of 5)</p>

Table 1: Comparison of the results between Group A (control) and Group B (treatment) (Continued)

Discussion and Conclusion

The insights gleaned from our study shed some promising perspectives on the landscape of Sustainable Business Model Innovation, particularly with a focus on the ideation process. We have delved into how participants reason during this critical phase, shedding light on how the introduction of distinct business model patterns can lead to the abandonment of certain cognitive constraints. By comparing the outcomes of teams equipped with sustainable versus traditional business model patterns, we offer valuable insights into the potential impact of these tools on the ideation process.

Our study yields a contribution and implications for research that unfold across three dimensions. Firstly, our investigation has brought forth noteworthy insights regarding Sustainable Business Model Innovation, specifically by examining the ideation phase's cognitive dynamics. We observed a departure from cognitive

constraints that traditionally influenced reasoning during the ideation process (Bitetti and Gibbert, 2022; Frankenberger et al., 2013; Guldmann and Huulgaard, 2020; Santa-Maria et al., 2022; Laudien and Daxböck, 2017). The integration of sustainable business model patterns emerges as a catalyst for broadening teams' cognitive perspectives, facilitating their departure from initial singular ecological focus. This alignment underscores existing literature, affirming that both formal and conceptual business model pattern cards, as well as visual tools, serve to stimulate business model innovation (Gassmann et al., 2013; Lüdeke-Freund et al., 2022; Täuscher and Abdelkafi, 2017). Furthermore, this discovery underscores the pivotal role that sustainable business model patterns can assume in promoting cognitive adaptability, thereby cultivating the emergence of inventive solutions that transcend conventional limitations. This insight adds a noteworthy dimension

to the extant literature, particularly in the context of overcoming cognitive constraints in business model innovation (Frankenberger et al., 2013; Laudien and Daxböck, 2017), by specifically highlighting the case of sustainable business model innovation.

Secondly, our study underscores the paramount significance of encompassing the social dimension in sustainable business model innovation alongside ecological and economic dimensions. While discussions surrounding sustainability have historically prioritized the ecological and economic aspects (Boström, 2012), our findings accentuate the pivotal role of incorporating social considerations. This alignment with previous scholarship underscores the necessity for a well-rounded integration of all three dimensions to achieve comprehensive sustainable outcomes (Bocken et al., 2016; Ceschin and Gaziulusoy, 2016; Lüdeke-Freund et al., 2022; Schaltegger et al., 2016; Stubbs and Cocklin, 2008). This recognition could potentially impact the imperative to reformulate existing business models in addressing sustainability issues among professionals, thereby preventing the potential of fully realizing sustainable business model innovation (Frishammar and Parida, 2019; Snihur and Bocken, 2022; Stål et al., 2022), and inadvertently neglecting the integration of socially equitable solutions (Rocha et al., 2019). The shift observed in Group B towards embracing social issues highlights how sustainable business model patterns can effectively incite teams to delve into these dimensions, thereby aligning their solutions with broader societal values.

Thirdly, our study makes a substantial contribution towards advancing the understanding of business models by effectively bridging two distinct interpretations, which are cognitive schemas and formal representations (Massa et al., 2017). We recognize that the choice of tools can significantly impact the mental interpretation process and outcome. Depending on the specific objective, certain tools might prove more effective in overcoming constraining cognitive tendencies inherent in business model interpretation. In this context, sustainability-specific business model patterns emerge as potent

tools to guide teams towards considering sustainability dimensions in their ideation process. This nuanced approach to understanding the interplay between cognitive schemas and tool effectiveness enhances our comprehension of how different tools align with specific goals, highlighting that sustainable business model patterns have a particular role in addressing sustainability challenges and the complex problems that design for sustainability requires (Ceschin and Gaziulusoy, 2016).

Collectively, our study advances the understanding of sustainable business model innovation by unearthing how cognitive processes and tools intertwine to shape ideation outcomes. Our study has some practical implications for innovation coaches and trainers that aims at helping companies to reconfigure their business model towards a more sustainable one. In fact, we suggest to adopt sustainable business model patterns as they stimulate cognitive processes and idea generation toward a more systemic and comprehensive view on sustainability.

There are several limitations of our study that entails only one experimentation with one classroom and that did not employ more sophisticated quantitative analysis. In fact, while the current study predominantly utilized qualitative analysis to examine the results, it is important to acknowledge the limitation of not conducting statistical tests, such as T-Tests, to ascertain statistically significant differences across groups, which could offer further depth to the findings in future research within the domain of sustainable business model innovation. In particular, the study only includes one experimentation and a limited number of students (i.e., 21), and results, despite plausible and interesting from a qualitative point of view, may not be applicable to real-world situations (i.e., managers of a company) beyond the classroom setting in which the experiment was conducted. Another limitation of our study lies in our approach to utilizing the pattern cards. We did not explicitly instruct the students to decide whether to entirely overhaul the existing business model or to augment it with sustainability ingredients. The majority of participants chose to incorporate

the pattern cards as supplementary elements rather than as overarching business model innovations. This nuance in interpretation could potentially impact the outcomes and implications drawn from our quasi-experiment. A more comprehensive investigation that delves into the differences between utilizing the cards for incremental sustainability enhancements within an existing model and employing them to instigate fundamental shifts in the entire business model could provide valuable insights. These limitations suggest further research opportunities. In particular, scholars may conduct a similar study in different organizations and explore how our findings evolve in a business rather than an educational scenario. At the same time, scholars may also replicate our study in different settings, with different classes of varying backgrounds. Moreover, future research endeavors might consider presenting students with distinct scenarios that encompass various typologies and modes of business model innovation (for example, business model reconfiguration versus design, or incremental versus architectural business model innovation) thereby offering a more nuanced exploration of the patterns' effects and the subsequent implications for sustainable business model innovation.

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