A Review of Frugal Innovation with Practical Implications for Educators

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Abstract. With a review of the major types of innovation (i.e. incremental innovation, radical innovation, disruptive innovation, exovation, inclusive innovation, reverse innovation, and frugal innovation), this paper focuses on frugal innovation, along with the key challenges of innovation adoption and the implications for practitioners in education. The associated obstacles and barriers that may impede the process of innovation diffusion are also explored. This study concludes with three recommendations for educators to bring innovation into the classroom, including: 1. Utilizing case studies (and lectures) to illustrate the basics of frugal innovation; 2. Creating positive learning environments and incorporating periods of “walking” in instructional design; 3. Developing e-learning capabilities. It is hoped that these actionable ideas can infuse elements of frugal innovation and inspire a culture of creativity within an educational context.

Introduction

Innovation has long been a topic of active discussion and intense debate in economic forums and technology conferences around the world, yielding technological advancements and business models that permeate all aspects of our daily lives. Defined as the application of better solutions for market needs, innovation is the basis for knowledge advancement, and almost every artifact of the modern world is a result of some form of innovation. [1] This paper seeks to study one specific type of innovation, namely frugal innovation, along with the respective challenges and practical implications for teachers within an educational context.

Literature Review

In this section, six major types of innovation, namely incremental innovation, radical innovation, disruptive innovation, exovation, inclusive innovation, reverse innovation will first be reviewed, before frugal innovation is examined. Each type of innovation, along with the respective defining features, will be elaborated and discussed below.

Incremental innovation generally involves product enhancements that are relatively small and minor, and only involve basic improvements upon existing technologies. [2] It does not bring about significant changes in a product or the associated consumption process. Representing changes that sustain an existing innovation, incremental innovation is characterized by gradual, marginal and linear changes within an existing framework or paradigm.

On the opposite extreme of the spectrum lies radical innovation, which engenders fundamental changes that are technologically revolutionary and distinct from existing paradigms. [3] This mode of innovation generally creates “a new paradigm to the market segment that modifies the existing business model”, according to the South American innovation firm Inventta. [4] Characterized by drastic, discontinuous and nonlinear breakthroughs, radical innovation often requires innovators to re-imagine what is possible based on new paradigms. Changes are targeted at the fundamental aspects of innovation, which results in transformations at a foundational level.
Coined by Professor Clayton M. Christensen at Harvard Business School (HBS), *disruptive innovation* describes a model in which innovators create brand-new markets and value networks that eventually replace existing incumbents. [5] The innovation process entails product improvements moving from a low-quality use case to a high-quality one, culminating in a process in which the innovator displaces current market incumbents in a disruptive manner. The essence of disruptive innovation lies in the dynamics and interactions between entrants (i.e. disruptors) and industry incumbents.

Exemplified by the process of disassembling and reproducing innovative products, *exovation* follows a “bottom up approach deriving technology transfer through the reverse engineering of distributed products from industrialized economies”. [6] This type of innovation centers on the process of knowledge transfer of technological knowhow from resource-rich to resource-constrained regions. Innovation usually comes from developed nations (e.g. OECD countries), which often have the necessary talents and wealth to dedicate to the research and development of innovative products. The process of reverse engineering these products for less-developed regions of the world is known as exovation.

*Inclusive innovation*, on the other hand, refers to the “development and implementation of new ideas which aspire to create opportunities that enhance social and economic wellbeing for disenfranchised members of society”. [7] Emphasis is placed on the inclusive nature of the innovation involved, targeting specifically the “disenfranchised members of society”, i.e. those at the bottom of the pyramid.

Another form of innovation, which entails developing products from innovation at the local level within developing markets and subsequently selling them to markets globally, is known as *reverse innovation*. [8] This type of innovation is characterized by a reversal of the manner in which it diffuses. Instead of following the conventional adoption route of developed-to-developing regions, reverse innovation originates from emerging countries, and becomes adopted in advanced nations afterwards.

Yet another form of innovation is *frugal innovation*, which is “the process of reducing the complexity and cost of a good, [including the removal of] nonessential features… in order to sell it in developing countries”, according to the Frugal Innovation Hub. [9] Previous studies have described frugal innovation as “cheap, tough, easy to use and developed with minimal amounts of raw materials”, [10,11] “good-enough, affordable products that meet the needs of resource-constrained consumers”, [12] “affordability-driven innovation”, [13] “scarcity-induced or minimalist innovation”, [14] and “a means and ends to do more with less for more people”. [15] Frugal innovation has a dual focus, which includes both efficiency (in terms of resource usage) and the associated scope of impact.

Armed with an understanding of the various types of innovation, we shall shift our focus to frugal innovation. Driven by national policy as articulated by Premier Li Keqiang, China’s initiatives towards innovation are rapidly transforming the nation’s economy. During the post-war era of the twentieth century when corporations resumed their innovation pursuits, much of the focus was on initiatives that benefited a targeted minority of elites, particularly those in society who were sufficiently affluent and could afford expensive inventions. [16] Frugal innovation is a form of innovation more frequently observed in emerging markets, and hence is more relevant within the context of China, as a lot of breakthroughs in technological developments and business models are no longer confined within the boundaries of ivory-tower-like R&D labs. This is mainly due to the relatively higher price sensitivity of local consumers. For example, not everyone in China can spend US$800 on a mobile phone (i.e. the iPhone), considering the fact that the per capita disposable income stood at RMB23, 821 (US$3,469) in 2016, according to Xinhua News. [17] The emergence of company strategies and business models tailored for these price-sensitive consumers paved the way for the rising prominence of frugal innovation.
Frugal Innovation Cases in China

Two cases of frugal innovation in China, namely Xiaomi and Ant Financial, are revealing. Accommodating the needs of the price-sensitive audience in China, Xiaomi, a Beijing-based electronics company, has managed to design, develop, and manufacture mobile phones with much lower price tags due to a business model that is strongly oriented towards cost minimization. The company reportedly sells its smartphones almost at cost, with prices 50-70% lower than those of phones of comparable quality. After its first smartphone release in August 2011, the company has developed a wider range of consumer electronics, including a smart home-device ecosystem that would form the basis for an “Internet of Things” (IoT). On the other hand, Ant Financial, one of the top fintech companies in China poised to go public in 2017 or 2018, is leveraging technology to provide financial services to the masses in a scalable, low-cost, and frugal way. Thanks to innovations in credit-profiling techniques driven by big data and artificial intelligence, Ant Financial has managed to provide loans for entrepreneurs as well as small and medium-sized enterprises around the clock, paving the way to benefit and serve the vast “unbanked” population in China.

Frugal innovation is particularly relevant in emerging countries, as consumers demand specific product features with a very price-conscious mindset, deriving utility in a different way compared to more advanced economies. Our discussion in the section below aims to shed light on the diffusion process of innovation.

Innovation Diffusion & Challenges

According the innovation diffusion model put forward by Rogers, the typical distribution of adopters over time could be illustrated by a bell-shaped curve (i.e. the normal distribution). [18] Adopters are classified into five broad groups spanning the spectrum of receptiveness towards innovation, namely “Innovators” (2.5%), “Early Adopters” (13.5%), “Early Majority” (34%), “Late Majority” (34%), and “Laggards” (16%).

Prior studies alluded to the concept of “cracks on the innovation diffusion curve”, pointing to the tendency for innovation diffusion to break down at some point. [19] Innovation adoption could lose steam, especially when various demographic segments have innately different characteristics and receptiveness towards innovation. Due to differences in psychographic profiles, the gap between “Early Adopters” and “Early Majority” (often known as the “dividing chasm”) is particularly significant, which is “by far the most formidable and unforgiving transition in the Technology Adoption Life Cycle”. [20] More open-minded and receptive to drastic changes, “Early Adopters” often regard innovation as a revolutionary breakthrough leading to transformative changes, and can often overcome a radical discontinuity with a leap of faith. On the other hand, those in the “Early Majority” segment tend to favor more incremental or evolutionary changes instead, and are more likely to yield to entrenched resistance. Evidently, some of the key challenges are not technological by nature, but psychological, and even political, cultural, and societal instead.

Challenges of innovation adoption in the field of education also abound. With the emergence of initiatives such as e-learning, the process of integrating technology into the classroom has long been a major area of concern and a subject matter of constant debate. Research centering on the issue of technology integration has identified two major categories of obstacles to change, namely first-order barriers and second-order barriers. [21] The first-order barriers are “extrinsic” to educators, and tend to be “easy to measure and relatively easy to eliminate” with money. [22] On the other hand, barriers that may stymie progress at a fundamental level are classified as second-order barriers. [23] The roots of second-order barriers can be traced to the underlying psychological beliefs of adopters, making this type of barrier an “intrinsic” one. When discussing the adoption of e-learning, for instance, Elgort described the adoption of e-learning technology as a “multidimensional process”, with problems that are “primarily associated with teaching and learning processes, rather than with the use of technology per se”. [24] Ingrown thoughts, pre-conceptions, as well as cultural and societal norms all play a role.

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in shaping second-order barriers, meaning that they are inherently more challenging to overcome. [25,26]

Studies have shown that smooth and seamless e-learning adoption would be possible only if the educators’ beliefs about teaching and learning are aligned with the instructional tools provided. For instance, if an instructor lacks faith in touchscreen technology (which, while prevalent nowadays, was a rarity about a decade ago before the first iPhone was released), using iPads to enhance the classroom learning experience would very likely be futile. The true potential of ICT would not be realized until educators “change how they teach, and not before”. [27] It is worth noting that psychological factors play a significant role in the adoption of innovation. The article Impacts of Personality Traits on Consumer Innovation Success by von Hippel, Stock and Schnarr features a study on the relationship between five broad dimensions of personality traits and the consumer innovation process, ending with a conclusion that certain personality traits (e.g. a high degree of openness to experience) are more conducive to the innovation process. [28]

Practical Implications for Educators

While the adoption challenges may seem significant at first glance, it is possible to tackle these challenges one step at a time, beginning with small, yet tangible, initiatives in our classrooms to navigate through the journey of adoption. A well-established field with institutionalized protocols and procedures, education has a long history, and is deeply rooted in its cultural and historical traditions. The effective and seamless adoption of innovation in education calls for a “reconceptualization of traditional teaching and learning paradigms”. [29] However, widespread innovation adoption will likely require the buy-in of multiple stakeholders, all of whom often come into the picture with preconceived notions and misconceptions, as well as competing interests and agendas. For now, taking baby steps and phasing-in changes would likely be the most viable approach in light of the many contextual factors (both institutional and individual) that may be resistant to innovative ideas and favor the status quo. Specifically, the following three recommendations are proposed to foster innovation and creativity in the classroom environment:

1. Demonstrate the basics (underlying theories and associated features) of frugal innovation via case studies and even the traditional lecture-based format
2. Design positive, productive learning environments allowing for the freedom of movement and encouraging outdoor activities, especially “walking”
3. Develop e-learning capabilities to incentivize learners and stimulate discussions of concepts related to frugal innovation

Recommendation 1. Case studies are effective instructional tools, as students are exposed to situations that call for novel ways to resolve difficult real-world problems. The case study method, which Harvard Business School (HBS) is renowned for, presents educators with a powerful pedagogical tool to immerse learners in thought-provoking scenarios spurring practical applications of innovation theories. For instance, Professor Christensen of HBS (who coined the term “disruptive innovation” in 1995) used examples from the disk-drive industry to showcase the process of disruption. [30] HBS cases, such as “Reboot Systems’ Refurbished Computers: A Frugal Solution for Digital Divide” and “Schneider Electric in India: Power Backup Products”, can form the basis for classroom discussions illustrating the various mechanics underlying frugal innovation.

Lecture-based instruction also has its own merits. Lectures, along with case studies, were found to be “positively related” to productive creative training. [31] It is worth noting that “lecture-based instruction was found to exert particularly strong positive effects on divergent thinking”, [32] highlighting the important role that the traditional mode of instruction still plays in educating the next generation of innovators.

Recommendation 2. Sometimes, the most effective way of approaching a problem is also the simplest. Researchers at Stanford University discovered a surprisingly simple way of enhancing
creativity: Walking. Experiments have revealed that walking, specifically walking outdoors, contributed substantially to divergent thinking. [33] Divergent thinking is central to innovation and creativity. [34] Incorporating periods that allow for similar types of activities can encourage divergent thinking, aiding the generation of creative ideas by synthesizing a multitude of solutions. This is especially useful for thought experiments on bootstrapping within resource-constrained contexts to explore frugal innovation.

Related to the concept of innovation is “insight”, a foundational element and one of the key building blocks of innovation. “Insight” is defined as “a sudden change in or the formation of a concept or other type of knowledge representation, often leading to the solution of a problem”. [35] Studies have shown that “positive affect enhances insight and other forms of creativity”, thereby contributing to innovation efforts. [36] Specifically, a positive mood leads to more insights by “increasing attentional scope to include weakly activated solution possibilities”. [37] Inducing a positive mood (or reducing anxiety) is one way to stimulate the generation of insights during the learning process. As such, a positive and encouraging learning atmosphere is conducive to innovative thinking and creative endeavors in the classroom environment.

**Recommendation 3.** Developing e-learning capabilities also helps unlock ideas for frugal innovation in the classroom. One of the emerging ICT applications infuses elements of game design and principles into the learning process via a concept popularized as “gamification” to motivate learners. For instance, while devising innovative, frugal solutions to problems can be challenging to many, incorporating elements of e-learning, i.e. gamification, can help augment the learning process. Research conducted at the University of Hong Kong indicated that “the use of game mechanics had a positive effect on motivating students to engage with more difficult tasks”. [38] Similar e-learning advancements can serve as a flexible and effective education technology tool to complement initiatives in educating innovators.

E-learning enhances and facilitates frugal innovation (and innovation in general) by providing instant and real-time feedback in the learning process, and allowing for rapid experimentation as creative ideas emerge. With e-learning platforms and virtual laboratories, students have the opportunity to create prototypes, conduct pilot studies, test out frugal solutions, and refine product features accordingly. Also, the cost of failure is lowered with e-learning, as unsuccessful attempts can literally be “rolled back” and the learning process re-initiated. This capacity for extensive experimentation helps accelerate frugal innovation pursuits as ideas and concepts can be put to the test rapidly.

With frugal innovation gaining prominence, finding ways to instill elements of frugal innovation into the learning process and inspire a culture of innovation for students in the classroom are paramount. The three recommendations above are a starting point for frugal innovation to make its foray into the classroom. While by no means perfect, they serve as a basis for education to play a more significant role in driving frugal innovation endeavors and advancing the global knowledge economy.

**Summary**

Based on a review of several major types of innovation, including incremental innovation, radical innovation, disruptive innovation, exovation, inclusive innovation, and reverse innovation, this paper focuses on the significance and practical implications of frugal innovation. Three recommendations have been put forward to bring innovation into the classroom, namely the use of case studies (and even lectures), the creation of positive learning environments allowing for the freedom of movement (most notably “walking”), and the development of e-learning capabilities (e.g. gamification) to incentivize learners and stimulate discussions. Armed with these practical recommendation and actionable insights, we hope that educators around the world would be better equipped to design learning environments for the next generation of entrepreneurs and inventors.
References


