Science, Technology and Innovation Studies

Alexander M. Sidorkin
Mark K. Warford *Editors*

Reforms and Innovation in Education

Implications for the Quality of Human Capital

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Introduction

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Alexander M. Sidorkin and Mark K. Warford

Most national governments have some sort of an education reform going on almost constantly. The interest arises from two major sources. First, labor economists (David et al. 2001) predict changes in the nature of labor markets across the developed world. The demand for nonroutine interactive and nonroutine analytic tasks is on the rise. The routine cognitive and manual tasks are in decline. These concerns prompted industry leaders to conceptualize the new demands on education and to describe the new kinds of skills needed by the future workplace.

The most prominent is the twenty-first-century skills framework[1] that has captured the imagination of policymakers around the world. It accepts the basic assumption that the share of manual and routine cognitive labor declines and the share of nonroutine cognitive labor increases. Therefore, we must reform education to provide students with skills more appropriate in the new economy: global awareness; financial, economic, business, and entrepreneurial literacy; civic literacy; health literacy; creativity and innovation; critical thinking and problem solving; communication and collaboration; information literacy; media literacy; ICT literacy; flexibility and adaptability; initiative and self-direction; social and cross-cultural skills; productivity and accountability; leadership and responsibility; and environmental literacy.[2] Stated mainly as a set of goals, the framework does not offer a clear way to achieve them. The problem of preparation for nonroutine

[1] *Partnership for the Twenty-First Century skills*, http://www.p21.org, *Assessment and Teaching of Twenty-First Century Skills (ATC21S)*, http://atc21s.org

[2] *Partnership for the Twenty-First Century skills*, http://www.p21.org

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cognitive work is difficult to address, for we have not yet learned how to measure skills that include critical and creative thinking and emotional and social intelligence, let alone how to develop them in most youth. Some of the most innovative work in educational assessment is being done to address the issue. For example, Patrick Griffin and his colleagues in Australia have combined data mining techniques with item response theory to produce a working prototype of an instrument for measuring ability to collaborate, readiness to take other's perspective, cooperative problem-solving ability, etc.[3] The Organization for Economic Cooperation and Development (OECD) has two separate international projects: one on social and emotional skills and another on creative and critical thinking.

It is important to note that the twenty-first-century skills are not really new. A certain proportion of the population have them now and had them before. Michelangelo was definitely a creative thinker, and Nietzsche had good critical thinking skills. What is new is the need to scale up those skills beyond the small intellectual and creative elite. For such a task, we simply do not have any instruments other than mass public educational systems. There is nothing comparable by the scale, by the potential ability to reach every child and most of young people, and by public and private investments in the infrastructure and personnel already made. But public education systems were created for a different society and a different set of skills appropriate for the industrial age. The task at hand is to figure out how education at all levels—from primary to tertiary—can be retooled to develop the twenty-first-century skills in the majority of the population.

Yet there are significant concerns about the ability of education systems to change. There are many worries, and we will only focus on three:

1. Unlike many other industries, education has hardly benefited from the information technology boom of the last three decades. Considering that it is largely an information-based industry, the little impact of information technologies on educational outcomes is, at the very least, peculiar. We seem to be always on the verge of one or another technological or organizational revolution in education for a long time now, and yet they never manage to materialize. There is little evidence to show that information technology does any good to schools and universities, partly because quality impact studies are actually quite rare (Blumenstyk 2016). The Organization for Economic Cooperation and Development has one of the most comprehensive data sets on learning outcomes for secondary students. The organization has been actively promoting informatization of education, and yet it found little evidence that information technologies have made significant impact on student learning outcomes (Schleicher 2015). We do not have comparable data on higher education; there is simply no way to measure student learning outcomes reliably. But no one can point at significant gains in higher education student learning because of the

[3]Griffin, Patrick, McGaw, Barry, Care, and Esther (Eds.), *Assessment and Teaching of Twenty-First Century Skills*, Springer, 2012.

technology infusion. Even anecdotally, one would be hard pressed to argue that today's university students are significantly better than their parents at creative and critical thinking, collaboration, and communication. It is implausible that the technology itself is to blame or that implementation has been flawed. Most likely, we deal with poorly understood institutional limitations within educational systems that affect their ability to take advantage of the technological innovations.

2. Another observable fact is the inordinate volume of educational reforming in multiple countries in most regions of the world. The standards-based reforms have been going on in North America and Europe for many years; a variety of reforming efforts are currently in place in Asia and in post-Soviet countries (Malone 2013). Many a reform come and go, and yet educational systems tend to reproduce themselves with a remarkable persistence. The "life in classrooms," as it was once described by Philip Jackson (1968), is still readily recognizable today, while the world around it has changed. One is already mentioned—they seem to be changing very slowly. Larry Cuban (2013) makes a case that actual classroom practices hardly change at all, despite waves of reforms that happen in the upper layers of the educational atmosphere. He writes about fundamental (second-order) and incremental (first-order) changes (pp. 277–295). Cuban sums up the effect of reforms: "Yet, overall, these first-order or incremental changes have largely left intact teaching routines that students' grandparents visiting these schools would find familiar" (pp. 168–169). And further, "basic instructional practices such as lectures, whole-group activities, question/answer recitations, textbooks, homework, blackboards, work sheets, paper-and-pencil tests persist. In short, continuity in classroom practice has trumped fundamental reforms in teaching" (pp. 175–177). The unusual stability of classroom practices has been noted by many scholars, for a long time. See, for instance, Goodlad (1984), Cohen and Hill (2001), and Sarason (1982). In education research community, there is little doubt that is it real, yet we still do not understand why this is the case.
3. Many national educational systems continue to become more and more expensive. In constant dollars, in 1920, Americans spent $355 per pupil annually. By 1990, the figure became close to $5000 (Snyder 1993, p. 59). By 2008/2009, these peaked to $11,621 and since then declined very slightly (NCES Fast Facts). For higher education, the trends are similar, with $15,772 per student in average for OECD country and $28 and $25 thousand for the USA and UK, respectively (OECD, Education at a glance, 2016). Besides struggling to control costs, education systems are still unable to close down the achievement gap, both for socioeconomic status and for race (Howard 2015). In other words, education does not seem to be able to solve its own two most profound problems. Given that the vast public education systems were created in part to mitigate inequality, the inability to cope with its own fundamental problems is worrying. Massification, achieving equity, and cost control are three sides of the same problem. The conversion to the twenty-first-century skills model requires

addressing all three, and whatever the solutions may be, they will require an openness to innovation.

Paradoxically, educational systems generate plenty of innovations. A report by the Organization for Economic Cooperation and Development (OECD, Measuring Innovation, 2014) placed education as the second most innovative industry after manufacturing. The findings are based mostly on self-reporting, but there is other evidence that innovations in education *are* being generated. Something must be going on with the way innovations spread and are sustained in education. Apparently, many innovations do not diffuse, and those that do only rarely "stick." This book is an attempt to start deciphering the genuine mystery of innovation diffusion in education.

We take the most basic definition of innovation found in the aforementioned OECD report, which is based on the definition by the *Oslo Manual* and which, in turn, ascends to the classic definition by Schumpeter (1912):

> Educational organisations, e.g. schools, universities, training centres, introduce (1) new products and services, e.g. new syllabi, (2) new processes for delivering their services, e.g. use of ICT in e-learning services, (3) new ways of organising their activities, e.g. ICT to communicate with students and parents, and (4) new marketing techniques, e.g. differential pricing of postgraduate courses. These new practices are intended to improve the education service in one way or another, and therefore, innovations in education should be regarded as "improvements." (OECD, Measuring Innovation, 23).

The definition is very broad, and it does not fit education perfectly, because as the authors of the report point out, educational organizations do not have one set of measurable outcomes. In other words, "improvement" is sometimes in the eye of the beholder. Yet it works reasonably well to capture the multitude of attempts to improve education through changing it.

Our overall initial hypothesis is that education stands aside from other social spheres with respect to innovation and change. In education, reforms may intend to speed up innovation, but in many cases have the opposite effect. Reforms may hinder rather than drive innovation. If we understand the causes of such phenomenon, we may be able to suggest how a new generation of reforming can be conceived. And understanding how it could be done depends on a critical analysis of how and why it did not happen so far.

This initial broad hypothesis led us to several questions: What kind of processes actually occurs to conflict with the pragmatics of making innovation diffusible and sustainable? How do innovations depend on certain institutional and human actors? This book is an attempt to consider possible reasons for the emergence of innovation-repulsive environments in education.

Education is a vast and diverse field. It encompasses everything from preschool to elementary, secondary, and tertiary education. Tertiary education, in turn, is split into vocational, mass, and elite sectors, as well as multiple branches by profession and types of institutions. In this book, we mostly deal with elementary and secondary levels of education, in their public forms. Where other sectors are

discussed, they are specially named. By default though, by "education" we mean elementary and secondary education.

A better understanding of reform and innovation is important for a whole range of educational stakeholders. For example, venture capital firms show growing interest in education. Yet businesses are often hesitant to invest, because it remains a puzzle how exactly decisions about innovations are made and why some fail while others survive. Better understanding of innovation may facilitate more interest from private investors, more awareness of the perils and peculiarities of innovation within the educational realm.

Similarly, there is an appreciable appetite among policymakers for making education more effective and less expensive. The main concern of policymakers is with the rising cost of education. It has to do with the seemingly unsustainable expansion of education without adequate (or any noticeable) increases in its productivity. By productivity we simply mean the volume of measurable learning divided by such inputs as student and teacher labor. The experience of other industries tells us that the path to higher productivity lies through innovation, although the rates of innovation differ significantly among industries. Understandably, everyone is looking for innovations in education that would play a similar role. For instance, the school choice theory (in both its voucher and charter school forms) is based on the premise that competition among schools will increase innovation. We see little evidence of that happening; therefore, the initial assumptions about the link between competition and innovation may have been misunderstood. Yet the interest in innovations is not a frill; it is at the core of educational policymaking.

Critics of educational reform abound, although there is relatively little understanding of the reform's apparently low effectiveness. The narratives of the corporate takeover of education or the dominance of neoliberal agenda in educational reforming only go so far. They often come short of proposing alternatives. We can enlist these critics as potential readers of the book.

And finally, various people within and without the formal educational system who consider themselves to be innovators may benefit from understanding the systems in which they have to operate. Championing an innovation, whether through commercial, or charitable, or public institutions and landscapes, is difficult and risky. A more sophisticated understanding of the innovation generation and diffusion may help innovators and reformers alike.

Human practices within organizations change in two fundamentally different ways: those of reform and innovation. Reforms are carried out by managers and intend to change how their subordinates work. Innovations are generated or adopted by those who change their own way of working. Thus, a school superintendent is more likely to be a reformer, while a school teacher—an innovator. At the same time, a school principal, who changes the way she does her own work, is an innovator. The same principal who encourages her teachers to change their teaching is acting as a reformer.

The distinction may seem arbitrary: after all, any reform can be conceivably called an innovation. However, if we focus on decisions effecting change, the

distinction between and the juxtaposition of reform and innovation are very useful. Everett Rogers, a pioneer of sociological innovation studies, considered all changes to be innovations. However, he did identify three kinds of innovation adoption decisions: (1) optional innovation-decisions, made by individuals; (2) collective innovation-decisions, made by consensus among the members of a system; and (3) "Authority innovation-decisions are choices to adopt or reject an innovation that are made by a relatively few individuals in a system who possess power, status, or technical expertise" (Rogers 2003a, b). In education, the latter kind is better known as reform, and we will refer to it as such. Through making a distinction, we focus our analysis on multiple interacting agencies in educational change and counter-change, in the context of institutional, organizational, and interpersonal arrangements.

Rogers' own prediction was that mandate to adopt innovation will increase the rate of adoption (2003). However, Fullan (2007) and Warford (2005) argued that at least in education, the opposite is true: mandates actually slow the rate of innovation. Our assumption is that it can go either way. That is, certain kinds of educational reforms will actually impede the adoption of the very innovations they intend to diffuse. Moreover, that kind of reform also creates environments generally hostile to innovation adoption. And yet we think that at least in theory, there may be another kind of educational reform that will facilitate innovation diffusion.

To illustrate the importance of the distinction between innovation and reform, let us try to think about two different kinds of processes even though sometimes they are difficult to tell apart. Sometimes a decision to change is made by both the authorities and the individuals or their groups. In fact, the entire discourse on policy implementation is about the interplay between the authority decisions to change and the individual users' decision to accept or reject any change. It is one thing to say "I want to try something different" and another thing to say "OK, you have now convinced me to try what you think is a better way of doing my job." The two types of change are intertwined and co-dependent, and yet distinct, for they differently answer the question—who decides to change and who is to change?

Consider why we have school reform in the first place. Reforming ultimately would be unnecessary if all rank-and-file workers realized the need to change and agreed on what the change would entail. But because some may perceive that the change does not happen or that it does not happen quickly enough, a concerted effort from the top is deemed necessary. At the same time, many (but not all) educational movements start their lives as grassroots innovative efforts and then transform into reforms in a bid to spread a successful method or approach. We also know that many such attempts fail to replicate the initial success, and no one is quite sure why. This dynamics frames the initial set of questions that concern us.

Why is it important to understand who makes decisions to change? Because we still have a fairly poor understanding of sustainable change in education. There exists a fascinating set of problems around how educational practices change.

Robust scholarship exists on the implementation of school reform, which more generally can be described as literature on educational change which was

mentioned by McLaughlin (1976) and Lieberman (2005). But implementation of policies is not the only way change is effected. While acknowledging the significant contribution of this literature, we would like to elaborate by bringing more attention to the notion of innovation. Teachers and principals are not only recipients of reforms, who embrace, misunderstand, or sabotage it. Rather, there is a dynamic and powerful force compelling educators to innovate. We know that educators constantly generate a healthy number of innovations. How those are communicated and adopted is a different story. Several chapters of the volume will show that innovation movements enter into complex and sometimes mutually canceling relationships with reform. They may or may not bring better results than the reforms. However, innovation is a distinct force of educational landscape and it deserves closer attention. It may be the case that when reform and innovation are in sync, change is more robust.

In fact, following Cuban's lead, we believe that educational reform has been disappointing, in part because the reformers put all the energy into creating structural conditions for innovation, without really understanding how innovations work and do not work in educational institutions. All attempts to import reforms from other spheres (business, technology, and manufacturing sectors) have been less than successful because of underestimation of the specificity of education as a social sphere and as a way of doing business. Cuban's own explanatory model involves the notion of "dynamic conservatism" (Cuban, Location 2839). He argues that educators constantly adapt to external demands of reformers by accepting only those parts of each reform that maintain stability. He thinks they are not simply ignoring change, but actively, creatively seek strategies to counter change. He does not, however, adequately explain why they are so vested in stability.

Without depriving the reader of the many connections between the chapters, following are some preliminary themes that emerge. They raise many more questions than answers, and the hope is that those questions unlock innovations in the study of educational innovations.

One of the hallmarks of this volume is that it lays the first bricks in the foundations of innovation. As affirmed earlier, Rogers' diffusion of innovations figures prominently across the chapters, but the reader will also encounter a rigorous examination of the very nature of innovations in tension with concepts like inventions and adaptations. Is it the nature of an innovation to shatter the paradigm or fold into the adopting system? This is a fundamental question that is addressed on some level in many of the chapters.

With regard to the economic foundations of innovation, this volume is truly a post-Cold War alchemy of East and West, and it affirms the maturation of research on educational innovations in the Age of Globalization. Human and social capital, labor economic theories are no longer the domain of tedious ideological ties. Rather, they are now the subject of global academic discourse, nourished by international entities like the World Bank and OECD. The collective voices of this volume also offer a healthy counter-narrative to the Titanic rise of economic globalization, full of grass roots and a dose of "innovation for the people."

With regard to innovation's political foundations, the reader will gain a sense of how innovation has traditionally been fueled by power struggles both between and within nation states. Much of the national-level innovation campaigns seem to go hand in hand with institutional insecurity and periods of economic stagnation. The cultivation of an (economically) industrious citizenry translates into calls for rigor or accountability, or even creativity, which leads to a critical examination of large-scale, top-down (mandated) innovations and an accounting for the failure of accountability.

This volume takes a closer look at educational innovation diffusion on a smaller scale. The layers and nuances of social and organizational systems are many, as are the questions that their empirical and speculative depictions raise. Rogers (2003) identified a tension between homophily and heterophily, like-mindedness vs. encounters across value systems. In reading through the chapters, we encourage you to pause to reflect on the relative value of solidifying existing stakeholder networks on both the source side and receiver side of educational innovation diffusion, on one hand, and, on the other, the spark that comes from breaking through barriers and unleashing new ways of looking at educational beliefs, practices, and technologies.

On a related note, a tension emerges between autonomy and homonomy, the need for self-determination balanced with the need to be woven into groups. Portraits of players in the educational innovation game likewise emerge either as entrepreneurial players in the economic-political theater or as benevolent social servants (or perhaps some degree of both?). Does this polarity split into competitive vs. collaborative conceptions of educational innovation diffusion? The distance between self and society, or subjectivity vs. intersubjectivities, may be more difficult for the reader to discern after reading these chapters, as we find educator agency challenged by a complex ping pong game of socio-organizational factors that may stifle or encourage the flow of educational innovations, a question that calls for a localized lens and the emergence of ecological or grass roots perspectives on educational innovation. However, without some sort of connection beyond the local system, the collective wisdom of this volume suggests such innovation communities will wither, though.

Finally, this volume offers the student of educational innovation a trove of methods, from quantitative to qualitative and empirical to speculative. There are many models for empirically rigorous research design and just as many critical reflections on the diversity of constructs used in such studies: what is the point of rigorously measuring something when we have only a dim perspective on what it is? This is a pivotal moment in research on educational innovations. In *Guns, Germs and Steel* (1997), Jared Diamond, depicts an east–west axis in technological evolution, flowing from the cradle of civilization, the Fertile Crescent in Mesopotamia. This discourse on educational innovation represents the culmination of this cross-continental diffusion. At the same time, given that many of the climatological and geographic barriers faced by our predecessors have been overcome by our innovations, perhaps it is time to unleash innovation in all directions, including the north-south axis and first, second, and third worlds?

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Educational Innovation Diffusion: Confronting Complexities

2

Mark K. Warford

2.1 Introduction

In order to test Rogers' (2003) linear and temporal arrangement of innovation diffusion variables in educational contexts, I constructed a Diffusion of Innovations in Education Model (DIEM, Warford 2005). The DIEM, as depicted on page 23 of the article, arranges aspects of educational innovation diffusion from antecedent (background) variables to process dimensions centering on the decision to adopt, and it culminates with consequences variables, which determine either the ultimate rejection or confirmation of the decision to adopt an innovation. This model obviously owes a debt to Rogers, who brought the field from which the model's name was derived (Diffusion of Innovations) into the social sciences from the field of agriculture (Ryan and Gross 1943). Henrichsen's (1989) adapted Diffusion of Innovations (DoI) model, which integrated cross-cultural diffusion variables, was also a major influence. The core of the DIEM, however, was informed by a parallel but otherwise ignored strain of diffusion research within the field of education, one that actually preceded Rogers' rise as the patriarch of DoI.

While honoring the educational foundations of research in innovation diffusion, the central—and ultimately linked—purpose of this chapter, is to critically examine some key studies, most of which are directly linked to preliminary proposals advanced in the DIEM. By its conclusion, the reader will see that we are coming home to some important discoveries regarding the nature of change in educational settings; this is not a "full-circle" but rather a spiral-like, emergent journey, one characterized by a confrontation with complexity and a return to notions of adaptation in early studies of educational change. As they say, "you can't return home." Likewise, this chapter will update notions of adaptation in educational contexts.

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2.2 Origins of Research in the Diffusion of Educational Innovations

In the diffusion of DoI, Rogers (2003), to borrow from the constructs he popularized, was the early majority adopter who propelled this field of research into the mainstream. The true *innovator* behind diffusion studies, as noted by Rogers himself, was Gabriel Tarde. No doubt influenced by the rise of evolutionary science in the nineteenth century and the steep arc of progress unleashed by the Industrial Age, Tarde posited that heightened interaction promotes the creation, diffusion, and imitation of *inventions*, products of genius alleged to propel cultural evolution. In particular, the complex orderliness or "fixed disorder" (1903, p. 164) of bird migration patterns inspired Tarde's theories. He later recognized that, rather than constituting a simple one-way communication chain from individual to social cognition, inventions were alleged to be honed and re-invented, often through conflict (Kinnunen 1996, citing Tarde 1903). With promising beginnings, Tarde's work was largely dismissed and overshadowed by Emile Durkheim of whom he was a fierce critic. That said, Tarde's influence is felt in fellow Frenchman, Pierre Teilhard de Chardin (2008). De Chardin, a Jesuit priest and evolutionary biologist credited with the archeological discovery of Peking Man, sketched out an interconnected consciousness, a *noosphere*, to which he attributed a convergent path of cultural evolution toward an eventual Omega Point at which all of the strands of the universe find harmonic interconnection. It is difficult to imagine that serious quantitative studies in diffusion have such visionary, mystical roots, but such may indeed be the case.

Though Diffusion of *Innovations* was picked up in agricultural research, the first major published diffusion study following Tarde's initial work came from Teachers' College educationist, Paul Mort, and his protégés, Francis Griffith Cornell and William Vincent. Mort and Cornell's (1941) regional case study of the diffusion of *adaptations* in the Pennsylvania education system was published a full 2 years before Ryan and Gross's (1943) Diffusion of *Innovations* study of hybrid seed corn adoption in the Midwest USA, research that would later be taken up and extended by Rogers in the 1960s (1962). It is estimated that the number of diffusion studies quadrupled at this time (Rogers 2003, in Kinnunen 1996), and it is clear that innovation, rather than *inventions* or *adaptations*, had emerged as the construct of focus in diffusion studies.

In his selection of the referent, adaptations, Mort implicitly acknowledged the highly mutable and multifaceted nature of new ideas and practices in education. As will be made clear later in this chapter, his "adaptations" framework may ultimately prove to be the best fit for diffusion research, at least in educational settings. Mort also, in a field alleged to favor the source rather than the receiver perspective on diffusion, honored the ultimate authority of the receivers of educational adaptations: "We have placed our faith in diffusion to a very high extent upon the initiation of individual communities and here given but little attention to the problem of how diffusion comes about" (Mort and Cornell 1941, p. 25). At the same time, his position was clearly on the source side of educational diffusion. When he claimed

that "the succeeding waves of "reform" which have come and passed in this century have left discouragingly little mark" (p. 3), he charted a one-way path for the diffusion of educational innovations (or adaptations): it is the practitioners, not the purveyors, who must *adapt*, though he lay most of the burden for the failure of educational innovation diffusion on poor oversight and lack of funding. At the same time, Mort's preference for an *adaptation* framework for educational change left the door open to us for an appreciation of the need for schools to fashion a fit between the innovation adopted and socio-organizational realities. Likewise, Rogers (2003) affirms the need for receivers to re-invent an innovation in order to optimize its fit within the adopting system, sowing the seeds of a paradox that must be worked out: educational innovations are not merely transmitted from source-to-receiver; rather, they are subject to a dialogic process of meaning negotiation. As will become evident, this post-linear view of educational innovation diffusion is a door through which a DIEM is destined to pass.

It is unclear whether the aforementioned spike in the diffusion of educational innovation research in DOI during the 1960s was due to Rogers (1962) or Mort and Cornell (1941), but studies in the diffusion of educational innovations reached a critical mass, that critical point in the S-shaped diffusion curve that sees a spike in adoption from early adopters that ensures enough momentum to secure an innovation's eventual destiny to graduate from innovation to status quo, as an *institutionalized* product or practice. Scholars like Carlson, Miles, Huberman, and others who took up Mort and colleagues' challenge to explore the complexities of the receiver side of educational diffusion were already established. At a conference on educational innovation, Carlson (1968), for example, observed: "School people seem quite prone to modify new practices in the process of adopting them. For example, what is called 'team teaching' in one system is very different from what is called 'team teaching' in another system" (p. 12). Around that time, Miles (1969) posited the necessity of school-based experimentation and integration into existing practices or *routinization*.

It is clear that an educational branch of the Diffusion of Innovations (DoI) had been established around the same time Rogers' highly influential model rose to prominence. Actually, it was precisely the complexities of DoI in educational contexts that influenced his emergent interest in the adoption and implementation side of diffusion. In 1968, he and Jain noted: "Teachers work in organizational settings like schools. . .And the organizational environment does have an important influence on teachers' innovative behavior" (p. 2). They also noted the potential of educational research for DoI, as it highlighted a bias "on the side of sources, not receivers of innovation diffusion" (p. 1).

In the years since, studies in educational innovation bring us back to the complex nature of implementation in school settings. Hunkins and Ornstein (1989), in summing up teacher use of educational innovations, concluded: "Implementation is in the eye of the beholder" (p. 112). Hall and Hord (2015) recognized that teachers vary both in their use of an educational innovation (Levels of Use Inventory) and their overall concern for the success of its adoption (Concerns-Based Adoption Model). Researchers have also endeavored to define the extent to

which educators should be permitted to adapt educational innovations. Leithwood and Montgomery (1980), for example, edified the notion of "fidelity," a construct that denotes predetermined agreements between change agents and adopters with regard to how an educational innovation will be used. Rogers (2003) and Miles (1969) openly embrace the notion of *re-invention* as a way of making an educational innovation more suitable to the adopting context. To some extent, such developments in research on the receiver side of adoption constitute affirmations of Mort's preference for the term *adaptation* over innovation in referring to new ideas and technologies in educational settings. The natural next stage of this development is the collapse of a unidirectional, linear model of educational diffusion, from change agents to adopting educators. Huberman's (1983) Linkage Model represents the first step. Huberman, to my knowledge, was the first to suggest folding the linear path from research-development-dissemination into a sort of trefoil of three interlocking circles. Rather than accepting the linear path of RDD (research, development, dissemination), Huberman recommended that basic researchers, applied researchers, and school-based users' educational innovations sustain interaction with one another to ensure that educational innovations are a good fit with adopting schools. In the decades since, as will become fairly clear in this volume, reforms and innovations in education continue to a top-down approach that often makes only superficial forays into fact-finding from practitioners on the implementation side of the chain.

In my regional case study of the diffusion of an innovation in language pedagogy and the role teacher educators played in that process (Warford 2005), the aforementioned studies served an invaluable role in better understanding the variability of educational innovation diffusion, perhaps raising more questions than providing answers. For example, rather than pinpointing adoption, this study raised more questions with regard to DoI constructs like diffusion effects and the various consequences of adoption (anticipated/unanticipated, direct/indirect, etc.). Mort and Vincent (1954) warned us that it may take up to 4 decades before the top of that "S-shaped" diffusion curve levels off completely, as the last "laggards" join the educational innovation wagon trail. In a way, the preceding portrayal of the history of research in the diffusion of educational innovations addresses some important emergent realities: new ideas and technologies in education are ultimately subject to *shared meanings*. In fact, the preceding discussion underscores the critical need for open negotiation and less hierarchical approaches to educational innovation diffusion. Many of the following recent studies were influenced at least indirectly by the DIEM article. A critical examination of the findings points to much-needed course corrections in coming to consensus on a model for educational innovation diffusion: a confrontation with complexity.

2.3 A Look at the Last Decade in Educational Innovation Diffusion Research

As already illustrated, a core frustration centers on the "eye of the beholder" factor; educational innovations, perhaps more so than other innovations, are subject to the complexities of shared meanings. My regional case study (Warford 2005) found that, contrary to DoI predictions, more knowledge of the innovation in question appeared to potentially undermine adoption and implementation. One might respond to this by simply mandating educational policies; forego the complexities of clarification and meaning negotiation with adopters in educational diffusion. As Markee (1997) warned, "Teachers are unlikely to adopt innovations that are based solely on basic research that they do not own" (p. 87). Considering that the one state in the region (Florida) that mandated use of the ACTFL Guidelines demonstrated the lowest measures of implementation, writing off the adopter perspective would be ill-advised. In summarizing my findings regarding the fit between DoI and educational context, I concluded:

> the nature of educational change is highly complex. While DoI provides a useful framework for conceptual clarity in designing and measuring the impact of educational innovations, it is clear that there are dynamic socio-organizational forces that are particular to the field of education—a finding that needs further verification in order to merit a significant contribution to a general theory of DoI. (Warford 2005, p. 28)

Since the DIEM's publication, a number of studies have provided rich and diverse source materials for exploring the rich complexities of educational innovation diffusion. The theoretical foundations and research designs represented in the following investigations range from well outside Rogers' classic DoI framework to a study conducted by Rogers, himself, toward the end of his career.

2.4 Units or Social Systems of Adoption: Marxist Perspectives

As mentioned previously, Rogers and Jain (1968) noted the strong socio-organizational factors that influence teacher adoption. The school organization presents a key factor in a teacher's adoption decision, and most of this section will focus on such organizational factors. However, we must accept the fullest possible valence of influences within the teacher's social system. Rogers (2003) defined the social system as "a set of interrelated units that are engaged in joint problem solving to accomplish a common goal" (p. 24). Sometimes, factors influencing teacher adoption decisions reach well beyond the brick and mortar of the school complex. For example, Abdelrehim's (2014) study of the diffusion of edublogs in Egypt found that the local community potentially undermined the adoption of edublogs, offering further support to similar findings in the DIEM study (Warford 2000, 2005). A common thread here highlights Rogers' (2003) distinction between "homophily," the easy flow of diffusion among like-minded

members of a social system, and "heterophily," which centers on the challenge of cross-channel communication chains. In both cases, community values were found to be heterophilous with those of the academy in ways that undermined educational innovation diffusion.

As state and corporate interests converge in the oversight of educational innovation diffusion, the circle of influences on adopting teachers expands ever outward. These change agents, often fueled by economic influences, are often leveraged against the perceived resistance to change in schools (Carlson 1968) or the need to put schools to work in producing professionals who can keep up with the fast pace of economic globalization (Titova 2014). Garleja and Skvorcova (2008), for example, frame innovative action as an optimal intersection of educational, economic, and sociopolitical spheres and as a focus for promoting student engagement. There are similar initiatives at work in the USA, the most prominent of which is the twenty-first century Learning Standards (Mansilla and Jackson 2011).

The USA has also seen the rise of mandates complemented by economic incentives and/or corporate interests. Federal mandates have used the granting or withholding of federal funding as a way to force change. Such initiatives have seen the rise of corporate involvement in educational reform initiatives related to teacher accountability measures and an increased role for standardized testing. In New York State, such measures have met with fierce resistance from parents, teachers, administrators, and even entire districts. At this writing, an "Opt-Out" movement has undermined implementation of standardized testing centered on the Common Core standards. Such developments recall Tarde's (1903) assertion that conflict is a necessary catalyst for invention diffusion.

The rise of state and corporate involvement in education has problematized the notion of an individual adopter-agent in DoI. (Neo-) Marxist epistemologies of being affirm the social nature of human cognition. In the past decade, studies influenced by such assumptions have drawn attention from the macro- to the microlevel scale of DoI, demonstrating how thinking is intricately connected to social context. The following are two studies of critical interest in the study of the diffusion of educational innovations. The first, influenced by critical theorist Pierre Bourdieu (1986, in Frank et al. 2004), demonstrates the alleged utility of social capital as an easily overlooked, informal factor influencing teachers' adoption and implementation of innovations. The second study was influenced by Activity Theory. Both studies share a common focus on the adoption of computer-based technologies. In discussing the role of social capital in the adoption of computer innovations, Frank et al. (2004) list three factors affecting computer innovation adoption: availability of hard and software, plus training (for teachers); organizational factors like leadership and scheduling; and finally, individual teacher characteristics (adopter characteristics, in DOI terms). Karasavvidis's (2009) activity theoretical study arrived at two conclusions regarding the adoption of information and communication technology (ICT) in education: the rate is low and implementation tends "to enhance traditional practices rather than transforming them" (p. 436). In their own distinct ways, both studies demonstrate the intricate connections between mind and milieu in the educational innovation diffusion.

2.4.1 Social Capital: A Macro-Level View of Educational Innovation in Educational Contexts

With an eye on implementation in educational settings, Frank et al.'s (2004) study challenges notions of the teacher as an individual agent in the use of educational innovations. The central construct of interest for the authors was *social capital*, a term fashioned and popularized by Bourdieu (1986) and constellated by other forms of capital, such as *financial*, *physical*, or *human* varieties. Social capital is constituted by "the potential to access resources through social relations" (p. 149). While affirming Rogers' (2003) focus on antecedent variables like size, complexity, and degree of centralization, as well as his framework for implementation (agenda setting, restructuring, clarifying, and routinizing), they argue that social capital is uniquely suited to educational contexts. In applying social capital to DoI in educational organizations, there are alleged to be two relevant realities of school work life associated with social capital: (1) "members of an organization derive important benefits from the organization, including social and psychological rewards, access to resources, information, and status" (p. 150), which promotes conformity and avoidance of being ostracized or "out of the loop," and (2) a sense of shared destiny applies collective pressure on individuals in the organization.

The authors argue that social capital may account for intraorganizational diffusion variables, including varying levels of implementation. In addition to social capital, job conditions, the related factor of job stress, and the influence of "societal tendencies" (p. 151) are other variables of interest. Re-working DoI around a mediational stance, the authors contend: "although traditional diffusion is conveyed through communication, its effects on the use of computers are mediated by actors' perceptions of the value of technology" (p. 151). Moreover, in ways that are at least indirectly rooted in Vygotsky's sociocultural theory of mind, the authors portray a (re)iterative process, propelled by social capital, which influences the collective perceived potential of an innovation within an organization. In this dialogic framework, novice implementers of an innovation (technology) are pressured to seek out experts, who, in turn, seek out novices to help because they know that successful integration of said innovation must address the weakest links. Such "intraorganizational networks" (p. 152) demonstrate the indirect nature of an educational organization's effect on teacher implementation. They also, though the authors do not make the connection, illustrate Vygotsky's Zone of Proximal Development (zo-ped or ZPD) (1978; 1986). The ZPD, traditionally associated with younger and disabled learners, essentially connotes the optimal distance between what learners (novices) can actually do on their own and what they could do, given strategic mediation (or scaffolding) orchestrated by an "expert-other." The ZPD has recently been extended to professional development, including teacher learning (see Warford 2011).

Frank et al.'s (2004) US study focused on six schools representing three states in two different regions (Upper Midwest & Southwest). Six teachers and one principal from each school were interviewed, and a sociometric questionnaire tracked diffusion chains. The survey was repeated for a second measure of implementation,

though one principal decided to withdraw his school from the study. The authors pass over this incident, but I would contend that this administrative shift variable is worth a closer look. Especially in high-needs schools, it is common for principals to be shifted around, creating an unstable and unpredictable testing ground for educational innovations. While studying educational diffusion in process holds the promise of richer, more attuned inquiry, researchers may place a burden on the process that is not conducive to implementation or to its study. Such disruptions as those depicted in Frank et al.'s investigation suggest that a case study approach centered on later stages of adoption may be more practical for school organizations and researchers alike. Another argument for case study is rooted in the fact that the researchers deemed it "not feasible to ask the teachers directly about others who exerted social pressure" (p. 156). Having some years of distance from implementation's *ground zero* may yield deeper, more candid information about the process.

In measuring implementation, the authors focused on specific cases of teacher use of computers "for each of five primarily educational goals and activities" (p. 154). In this way, the researchers underscore the importance of attending not only to the quantity but the *quality* of implementation. The researchers also measured teacher interactions with a focus on those of an *informal* variety. As they put it, "Social capital is observably manifest when one actor allocates resources to another through interaction that is not formally mandated" (p. 155). Implicit in their assumption here, and perhaps in the social capital construct, in general, is that teachers prefer to be educated by other teachers.

Other features of the study included a control for initial teacher expertise with computers in measuring implementation, which nuanced ratings of organizational support. In measuring relative advantage, the authors provided stems for teachers to complete ["Computers can help me. . ." (p. 156)]. This measure was complemented by another measure of "perceived potential," which sets a continuum from potential for students to potential for teachers. Other variables included computer resources, job conditions, job stress, the school, and background measures (antecedent variables). Dummy measures were added to counterbalance the potential intervention of "state or district institution" (p. 158) particularities. The complexities of localized perspectives underscore the need for researchers to ground themselves in more emic understandings of educational innovation use.

Results indicated a total of 196 different classroom uses for computers per year, which further supports characterizations of educational innovation implementation as complex and perhaps highlights flexibility as a particularly favorable innovation characteristic in DOI. Students and teachers alike indicated support for teacher use of computers, with means just above the neutral zone in agreeing with statements underscoring the "perceived potential" of computer-integrated instruction. Teachers reported being busy, in part due to policy mandates (No Child Left Behind) and increased "emphasis on standardized tests" (p. 158); both of these effects were statistically significant. Social capital partial coefficients were moderate for "access to expertise" (p. 160) through peer interaction, "social pressure to use computers," and potential for teacher computer use. With regard social capital,

"access to expertise through help and talk" and "perceived social pressure to use computers" (p. 160) emerged as significant influences on teacher computer use and accounted for most of the variation in implementation. The authors also underscore the shifting importance of social capital in the diffusion process; it may not play a central role where there is extensive teacher acceptance of the innovation.

This micro-macro dance between the individual adopter and school organization may multiply exponentially as we venture out into the larger social system. Clearly, the complex socio-organizational forces that influence teachers' use of educational innovations are too complex for direct access by a change agent. Just as Rogers (2003) advocated for *opinion leaders* and *aides* from within the adopting milieu, the authors suggest the recruitment of change agents among the teaching faculty. They also suggest that these change agents attend to issues of job stress.

On a related note, Hall (1992) warned of a *development-implementation imbalance*, with way more innovations in the pipeline than could possibly be taken up by schools. Here in New York State, the tsunami of new certification standards for teachers, the Common Core overhaul of curriculum design and standardized testing, and a high-stakes Annual Professional Performance Review were trotted out within a 2-year period. The fallout is still being felt in teacher and parent protests, "Opt-Out" testing boycotts, and steep declines in enrollment in teacher education programs. Resistance to these trends fueled the campaign of the only viable challenger to Governor Cuomo in the last election. Adding to the growing body of studies underscoring the toxic effects of (policy) mandates (Fullan 2007; Warford 2005), Frank et al. (2004) argue that, however well-meant, (policy) mandates, have a negative impact on social capital. Social capital, as with more material forms of capital, is a finite resource. Somewhere in the midst of such realities, the classic compensatory function of conflict, first posited by Tarde and later espoused by Bourdieu, reaffirms itself as a virtue in its own right.

2.4.2 Activity Theory: Microlevel Perspectives

As we move from the macro- to the microlevel, the idiosyncrasies of educational diffusion's implementation emerge. We also find a more direct connection to the legacy of the Russian social psychologist and linguist, Lev Vygotsky, in the study of educational innovation diffusion. The reader will recall that the respondents to Frank et al.'s (2004) study tallied 196 ways of using computers in the classroom. Even a straightforward technological innovation is recrafted and subordinated to shared meanings. The "eye of the beholder" perhaps should be rather thought of as the eyes of the beholder. Teachers are social agents. Cognition, at the epistemological root of Vygotsky's sociocultural theory of mind, is social; it has many eyes. It also has many ears and tongues. Within a linguistic frame, he drew the distinction between *znachenie* and *smysl* to highlight the multiple connotations that dynamically constellate around an arbitrary denotation (Vygotsky 1986). As regards teacher use of educational innovations, high school teachers are often asked by professional development personnel: "adopt, adapt, or ignore?" Applying

a Vygotskyan framework to the DIEM, one might conceptualize the adopt/adapt distinction as similar to the *znachenie/smysl* distinction. Both Rogers and Vygotsky would also accept the null set constituted in "ignore." In DoI, this would be synonymous with rejecting an innovation. In Vygotskyan terms, cognitive development is subject to an "affective-volitional" (1986) dimension; in other words, I as a teacher may not be at all concerned with X or Y educational innovation and consequently not expend any effort to understand or use it.

As affirmed by Karasaviddis in his contribution to this volume, Activity Theory represents a third stage in the evolution of Vygotskyan research (van Lier 2004), Activity Theory has perhaps the most promise for deepening our knowledge of implementation of innovations in educational settings. Karasavvidis's application of Activity Theory to the study of information and communication technology (ICT) adoption among teachers represents a unique contribution to the educational diffusion literature, as it affirms the teacher as a "crucial mediating factor" (2009, p. 437). In exploring technology adoption and implementation from the perspective of teacher concerns, the author offers us a more emic perspective than more quantitative approaches [i.e., Concerns-Based Adoption Model (CBAM) (Hall and Hord 2015)] are equipped to measure, dividing teacher concerns into two realms: time and compatibility, variables of interest in DoI, particularly since the latter is one of Rogers' key innovation characteristics. For a closer discussion, the reader should consult Karasaviddis's chapter in this volume.

The triad Karasaviddis depicts, in DOI terms, connects the adopting subject to an innovation-object through a triad of antecedent socio-organizational variables: rules, community, and division of labor. Though all three variables were employed by Frank et al. 's (2004) social capital framework, the organizational variable, division of labor, is of particular interest, in light of their finding that teachers already perceive their workload as overtaxed. Already, we see that a deeper understanding of teachers' experience of adoption and implementation is weighed down before the diffusion process kicks in. Borrowing from Frank et al., one might envision the additional varieties of human capital (financial, physical, human) on the right side of the CHAT triangle's base (community, division of labor). The critical insight of CHAT, and Vygotskyan theory in general, is that all of this activity is not merely a linear process of transmission, as classically conceived in DoI, but rather *mediated*. In other words, the meaning of a particular innovation (object) and its use certainly fit Hunkins and Ornstein's (1989) "eye of the beholder" characterization, referenced earlier. This shift from top-down transmission to a more grounded, mediational view of educational change has tremendous implications for expanding conceptions of innovation diffusion in educational settings, and time and again, the crucial factor to which reform campaigns continue to be oblivious is this primacy of "existing teacher beliefs, perspectives, attitudes and practices" (Karasaviddis 2009, p. 438).

DoI views mediation as a phenomenon of verbal and print-based communication networks ("channels"), though it perhaps needs to be updated around the increasing availability of web-based resources. Karasaviddis's (2009) concept of "mediating artifacts" reflects the classic sociocultural theoretical notion of psychological

(semiotic) tools that take physical form (what is on a screen, a printout, a newsletter), though it is also capable of containing verbal forms of mediation, which resemble the classic "communication channel" focus of DoI. With regard to the study, this phenomenon manifested itself in the CHAT triangle through a multitude of broken lines of communication, including object contradictions, mediating artifact and object contradictions, and current vs. proposed object contradictions; educational innovations truly are in the "eye of the beholder."

In synthesizing the findings for Frank et al. (2004) and Karasaviddis (2009), one finds important lessons for DoI research. First, it is problematic to conceptualize the teacher in isolation as an individual adopter. To extend Hunkins and Ornstein's (1989) "eye" metaphor, a teacher beholds educational innovation through multiple sets of eyes. Second, the adoption and implementation of educational innovations is subject to a complex and dynamic interplay of shared meanings that stretch from individual teacher cognition to national mandates. Even the most "straightforward" technological innovations are subject to varied interpretations. Consequently, the third lesson regards teacher job stress in the current predicament of innovation overload and mandated high-stakes testing.

2.5 Testing New Statistical Models for the Diffusion of Innovations in Education

Two recent statistical studies from Southeast Asia demonstrate how factor analytical approaches generate highly nuanced measurements of educational innovation diffusion. Leejoeiwara (2013) employed Decomposed Theory of Planned Behavior (DTPB), a statistical model guided by structural equation modeling, which was used to highlight factors that influence Thai students' ($N = 542$) adoption of online learning. Leejoeiwara adjusted some of the variables around a better balance between source and receiver varieties and added a self-directed learning factor, which, as it turned out, accounted for nearly a full third of the variance in the path to adoption, a result that echoes Koroleva and Khavenson's findings (see their chapter in this volume) regarding the self-determination of innovators in education. Rogers' key innovation characteristics contributed as well, with the exception of trialability and relative advantage. With regard to the latter, Leejoeiwara attributes its low loading to the fact that few Thai students have a frame of reference for online learning or its alternatives.

A complex dynamic of social factors also emerged. Interpersonal relationship influenced the adoption decision, and Leejoiewara connects this to Rogers' observability characteristic, suggesting that seeing others use the innovation was a facilitative factor. These perceived respectable others, and other stakeholders in the respondent's milieu heavily influenced the adoption decision, a finding Leejoeiwara attributes to Hofstede's (2001) concept of "face" in collectivistic cultures. Interestingly, and contrary to Hofstede's theory, attribution of "superiors" seemed to have little influence on respondents. The significant loadings for self-directed learning further contradict Hofstede's distinction between Western individualism and

Eastern collectivism. The author concludes that the decision to adopt online learning involved a complex mix of both social *and* personal factors.

Multi-Criteria Decision Making (MCDM), also amplified by structural equation models, facilitate a deeper understanding of decision-making processes in educational innovation diffusion. Durlak and DuPre (2008, in Tang et al. 2015) followed a hybrid variety of MCDMs called DEMATEL-ANP (Decision-Making Trial and Evaluation Laboratory-Analytical Network Process). In studying an "English for Specific Purposes" immersion program targeting international Meetings, Incentives, Conferences, and Exhibitions (MICE) professionals, Tang et al. (2015) tested the strength of various predictions related to educational innovation implementation. Five key factors emerged: external (change agent) factors, provider characteristics, innovation characteristics (compatibility, adaptability, complexity), organizational capacity, and adopter characteristics (teachers and students).

Results of the DEMATEL survey yielded centrality and cause degree measures at both the dimension and factor level. With regard to the dimension level, centrality degree measures on innovation characteristics and school board leadership, respectively, received the highest scores. Among the cause degree results, factors related to individual adopters received the highest scores, whereas "school culture" registered no outputs and received the lowest score, securing its status on the receiving end of the adoption process. The latter findings contrast with the growing consensus that innovation adoption in educational settings is a particularly sociocultural (rather than an individual adopter) phenomenon, though this phenomenon may be specific to business education (tourism). In any case, measures of centrality degree nuanced this finding; the two highest scores were for cooperation and communication within the school and school leaders' support for the planned implementation.

Highest cause degrees were found in an adaptability factor, which emerged as the "master dispatcher," whereas organizational norms regarding change received the lowest scores, placing this factor firmly on the receiving end of educational innovation diffusion. Adaptability constellated with six other factors seen as a dispatcher cluster: coordination with external agencies, funding, perceived need for the proposed innovation, teachers' attitudes and concerns, compatibility, and perceived benefits of the proposed innovation, which echo Rogers' relative advantage construct. The latter results, when compared with its rather meager impact in Leejoiewara's study, suggest the need to clarify relative advantage in educational studies: relatively advantageous to what?

Synthesized global weight scores yielded the following top five factors: adaptability, compatibility, funding, coordination with external agencies, and teachers' persistence. However, in addition to the dimensions of characteristics of the innovation and factors relating to individual adopters, school board and president leadership loaded highest in pre-synthesized global weight rankings and "cause degree" measures, which further nuance the complexities of the socio-organizational element uncovered in Leejoeiwara's (2013) findings.

Top innovation characteristics in measures of global weights further supported the case for attention to adaptability [more or less synonymous with Rogers' (2003) notion of flexibility], compatibility, and complexity (-) as important influences on adoption at the implementation stage. A cluster around perceived need and perceived benefit under school board and principal leadership suggested that these factors exerted a particularly strong influence on implementation. In part, and invoking Hofstede (2001), the authors attribute this influence to "high power distance and high uncertainty avoidance" (p. 17) in Taiwanese culture. Overall, engagement with external change agents and the active support of educational leadership were determined to be essential in promoting and sustaining adopter involvement in the implementation process. So, again, we collide with this complex nuancing of socio-organizational factors, here raised in Leejoiewara's study (2013).

Leejoeiwara (2013) and Tang et al. (2015), in their own ways, statistically map the socio-organizational influences on adopter behavior noted in studies in classic DOI research as well as within Marxist approaches to the study of educational change. Without diving too deep into the particularities behind the range of impact from socio-organizational factors, two things are clear: (1) Hofstede's collectivistic-individualistic culture distinction fails to fully account for the results in these studies and (2) the social element is subject to questions of "who" influences the adopter and the related question of "how." With regard to both points, what is novel and intriguing in these studies is the possibility of imagined others who act as unseen cognitive coaches in the intention to adopt and implement educational innovations. In both studies, these imagined others were not necessarily the authorities in the particular educational organization of interest in the adopter's context. For example, the leadership in the adopting system was a relatively insignificant factor for Thai students in Leejoeiwara (2013), whereas Taiwanese respondents in Tang et al. (2015) were influenced by school authorities.

With regard to innovation characteristics, both studies underscore the importance of room for the complexities of localized interpretation of the targeted innovation. Within this zeitgeist, we find from both studies that a factorial approach tells us more about the critical importance of adaptability, this "master dispatcher" factor, that may subordinate related facilitative innovation characteristics in DoI that have traditionally been considered in isolation as discrete variables.

2.6 Case Study Approaches to the Study of Educational Innovation Diffusion

As mentioned earlier, a case study approach pinpointed to the end stages of educational diffusion offers less disruptive and more face-saving alternatives to studying diffusion at the height of the process. As studies like Henrichsen's (1989) study of the diffusion of a particular program of English language teaching in postwar Japan and this volume's study from Safronov, which investigates shifting approaches to educational reform in Russia over the past several decades, additionally afford the sort of perspective that benefits from a sort of historical alchemy that

is not possible *in processus*. However, pinpointing the exact endpoint of adoption is clearly a more complex task than one might imagine. Shifting the focus from innovation to *adaptation*, it is easy to imagine the top of the "S-curve" as interminable, particularly in educational settings. The reader will recall that Mort and Vincent (1954) estimated that it takes at least 4 decades for an educational *adaptation* to truly take root in an adopting system. Due to the sublime and emergent nature of educational innovation implementation, more grounded measures are needed to provide the necessary "color commentary" with regard to the diversity of ways adopting systems re-invent educational innovations. This was one of the identified needs in diffusion research that have validated the incorporation of qualitative methods of data collection (Rogers 2003; Campbell 2015). Case study research may indeed be a good fit here. While Mort and Cornell (1941) and Warford (2005) primarily used scale survey data and Henrichsen (1989) relied mainly on historical records, more recent case studies employing mixed method designs point to the utility of integrating qualitative and quantitative data collection methods, deepening the discourse on ways to optimize the fit between DoI and educational contexts.

Campbell (2015) followed an "instrumental case study," defined by Creswell (2008) as "in-depth exploration of a bounded system" (p. 476), which may have spatial and temporal dimensions (space or time); the case is seen as subordinate to some larger issue or the testing of a particular supposition. His investigation of implementing videoconferencing (VC) technology in undergraduate-level distance nursing education involved a combination of the following methods of data collection: direct classroom observation (40 h), personal interviews, focus group interviews (one for each of two groups involved in distance education through VC) of nursing students experiencing VC technology ($N = 32$), and end of course (EOC) summary statements. After triangulating the data, results indicated that only 6 of the 32 students adopted (accepted) VC as implemented, which is of interest, considering that, according to Campbell, campus survey data suggested widespread acceptance of VC 6 years prior to his study. These results find favor in long-standing folk theories about the generally slow pace of educational change alluded to earlier. They also have very important implications for the dubious pursuit of an adoption "pinpoint" in mainstream DoI. That said, 14 students accepted (adopted) VC with *modifications*. VC may have made it past the first rise in the "S-shaped" curve; it has hurdled the point of no return, but what it *means* to adopt VC will be subject to the adaptive process of re-invention.

With regard to the remaining 12 students who rejected VC, all representing the receiver classroom in the VC arrangement, one conjectures about the potentiality of fully one-third of the adopting students, all representing the receiver side of VC, a group that was disadvantaged to the tune of 18.53% points on NCLEX-RN exam pass rates; to what extent does their rejection constitute a pressure on the administration to put the brakes on VC adoption and implementation? Campbell's study pointed to five points of re-invention necessary to facilitate VC implementation, including interaction (student perceptions of faculty ranked highly in influencing adoption of VC), equipment, and pedagogical modifications, as well as increased

instructional technology, including a student orientation. The study also confirms that pinpointing confirmation of adoption in educational settings demands the exploration of multiple perspectives, including those of non-adopters (Rogers 2003): while the administration declared victory, students were clearly more skeptical of the decision to adopt VC.

Kamau's (2014) case study investigated the diffusion of applied behavior analysis (ABA), a curricular approach in the education of students with autism. Following a *multiple case study* approach, Kamau's study centered on the nature of hindrances to the development of ABA-based autism programs. Four factors emerged as constituting obstacles to ABA adoption: characteristics of the innovation, lack of resources, adopter (intended-user) characteristics, and systemic factor. The combination of these factors pointed to the need for a collaborative model of teacher and support staff professional development, education of special education administrators with regard to ABA implementation considerations, and a more prominent role for ABA and autism research in programs involved in the education of autistic learners. Kamau's (2014) study further corroborates my finding (Warford 2005) that the diffusion of policy mandates is undermined by their lack of attention to the complexities of the receiver side of educational innovation diffusion (Rogers and Jain 1968; Warford 2005).

Selection of an "adopting unit" for a case study, as is the case with any study of the Diffusion of Innovations in education, must address the complex micro- to macro-level influences on educational innovation adoption, including time or space (perhaps both!) dimensions. The focus may range from the level of one school to an entire region. There may be many justifications for calibrating the case study to a particular level, but it is incumbent upon the researcher to make the "case." Sampling, as with qualitative studies, in general, is usually purposeful (Campbell 2015, citing Flick 2007; Kamau 2014; McCracken 1988). Why? Unlike quantitative studies, the selection of participants (not subjects) is representative (rather than exhaustive) (McCracken 1988). Case study selection options run the gamut. Campbell (2015), focusing on one particular school organization, selected the largest undergraduate nursing program in the southeastern US region. Whether at the pilot, exploratory stage, or within the study proper, open-ended personal and focus interviews are essential (Campbell 2015; Kamau 2014) in order to stay within the grounded, emic perspective of the targeted adopters. Document analysis (meeting minutes, executive summaries, relevant commentaries in the professional literature) is also an important component of any case study in educational innovation diffusion (Kamau 2014; Warford 2000). Direct classroom observation serves as a reality check on innovation implementation (Campbell 2015) and provides a more grounded portrait of the ways educators adapt (re-invent) educational innovations in order to create a better fit with their organizational context, especially with regard to the highly subjective nature of more abstract "principles-based" innovations (Warford 2002, 2005). Re-invention is generally accepted as a facilitative factor in promoting sustained innovation adoption (Rogers 2003, in

Campbell 2015). In school organizational settings, the verified success of a particular innovation in one program may catch on in another (Campbell 2015).

The question was raised earlier in this chapter regarding the relative value of studying educational innovation diffusion in progress or after the fact. With regard to more qualitative approaches like case studies, the researcher should consider that students and teachers, the more vulnerable respondents down the chain in the educational organization, may be reluctant to deviate from administrative pressures to support the innovation in question. Defying such risks, Campbell (2015) and Kamau's (2014) in-progress approach may have started crucial conversations within the adopting schools, thus sparking re-invention in the implementation process.

2.7 Complexity and Emergence in Educational Innovation Diffusion

The complex and dynamic interplay of mind and milieu in the diffusion of educational innovations accounts somewhat for the lack of fit between Rogers' (2003) Diffusion of Innovations (DoI) model and my own study of the diffusion of educational innovations in the southeast US (DIEM) (Warford 2005). The historical foundations of innovation diffusion studies and the recent research on educational innovation diffusion appear to support a more complex picture. Consequently, future research on educational innovation diffusion should consider two emergent fields in complexity theory: Complex Adaptive Systems (CAS) and Dynamic Systems Theory (DST).

2.7.1 Complex Adaptive Systems

Shortly before his death, Rogers and colleagues (Rogers et al. 2005) integrated findings from research in Complex Adaptive Systems (CAS) into DIM, conceding that the Diffusion of Innovations model (DIM) may not be so linear and deterministic, when integrated with a CAS perspective: "Most real life situations, on the other hand, are complex. Small changes in initial conditions, and later interventions of whatever size, can result in disproportionately large effects" (p. 3). A CAS, according to the authors, is characterized by the dynamic interaction of a diversity of agents that derive sustenance from the system's *local rules*, while simultaneously making use of *network neighbors* (citing Klein et al. 2003). Since the environment changes, the system must adapt through the attainment of greater levels of "group cohesiveness and order" (p. 3). A confrontation with heterogeneity initially upsets the system's equilibrium, sending it into a *bifurcation cascade*. It is these catalyzing heterogeneous zones that are of principal interest, since such "transitional space" open a path to differentiation led by local innovators and cosmopolites who otherwise would not be interconnected. These transitional, heterogeneous spaces tie stakeholders to external systems.

In comparing CAS with DIM, the authors affirm a common emphasis on emergence (adaptation, in CAS; adoption, in DIM). Both models also share emphasis on growth toward "a higher-order, fitter system" (p. 4). DIM traditionally favors homophilous over heterophilous channels, though Rogers et al. find convergence with CAS at the "threshold of criticality" (p. 4), when relatively weak, *hetero*geneous networks challenge the complex adaptive (or adopting) system to pass through the crucible of change in order to accommodate some new agent representing a larger system configuration. Failure in both CAS and DIM "often occurs because members were inhibited in their ability to adapt interdependently, failing to rise together to the minimum threshold of fitness required for adaptation or adoption" (p. 4).

In discussing the mathematical foundation, Rogers et al. (2005) essentially characterize the shift as one from unidimensional time (of adoption) to multidimensional (phase) space. Rather than looking solely at time-centered adoption curves (s-shaped), the model expands into three dimensions, creating a dimpled topography of basins of attraction into which water flows. These basins of attraction, according to Rogers et al. (2005), resist alteration, with the exception of certain key stages: at the beginning, characterized by the initial influence of early adopters, represented at the slow rise at the bottom tail of the "S-curve," and the subsequent momentum boost at the second rise as majority adopters hasten the institutionalization of the innovation. According to Rogers et al., bifurcation points may, if they are temporally asymmetrical, point to a CAS, in which case the bifurcation cascade is unleashed, and there is no return home to the way things were before; if symmetrical, then the system is essentially deterministic and not complex, and it is possible to reverse the diffusion back to the original antecedent state prior to the diffusion campaign. In Karasavvidis' (2009) study, for example, the pressures of standardized testing originating in a Cretan policy mandate undermined the chance for ICT's successful diffusion and adoption, at least in any deep sense. It may be revealed in future studies that educational systems under pressure to prepare students for standardized tests are deprived of adaptability, or as Sidorkin has suggested in this volume, such innovations sap innovativeness. In either case, the result is the same: a brittle, fossilized CS (complex system) rather than a CAS and shallow implementation.

Rogers et al. (2005) expound on variety, reactivity, and heterophily in a hybrid CAS/DIM context. In CAS, variety is a principle of diversity within a system that is roughly equivalent to the DIM construct, heterophily. In both cases, there is some optimal threshold of difference required for the system to satisfy the requirements of "adaptation and emergence" (p. 6). This sense of balance in the change process also lends support to Kirton's (2003) adaption-innovation continuum, which posits an optimal balance of conservative, tried, and true stability with the sort of fresh thinking required of organizations in the Knowledge Age. However, rather than connoting a sort of harmonious balance, CAS describes a sparky but necessary *reactivity*, a "sensitivity to change" (p. 6) in these heterogeneous zones, on the periphery of the system, where emergence is initiated. Emergence finds momentum in a bifurcation (or change) cascade toward greater systemic fitness. This process is

not a sort of harmonious, zen blend but rather a precipitous crack in the systemic dam, a disequilibrium that leads to more resources and ultimately a greater, more complexly self-organized equilibrium. To return to Tarde and Bourdieu, it is not hard to imagine a lot of conflict here.

A closer look at the onset of bifurcation or in CAS, "criticality," finds fit with the notion of "critical mass" in DIM, where it denotes a spike in the diffusion curve, the rising sections of the "S-curve." Heterogeneous chains of early adopters, according to Rogers et al. (2005), account for the first spike, and this is not at all a comfortable position. As the authors state: "potential adopters, wholly located on the fringe or edge (the highest reactivity heterogeneous zone) of a system, are seldom certain about whether an innovation is a superior alternative to what they already have or do" (p. 8). That first spike, they argue, depends on a confrontation with uncertainty within the adopting (or adapting, in CAS) system. Social norms (rules, in CAS) have to be recalibrated in order to get to criticality. Criticality momentum at the heterogeneous fringe finds itself in a synergetic connection with adjacent agents in neighboring systems, as meanings of "fitness" and "fitness rewards" find themselves in a sort of infectious flux around the innovation. Campbell (2015) uncovered this adjacency dynamic in the spread of VC technology from nursing programs to other departments at the university under study.

As pointed out previously, Rogers et al. (2005) attribute the second spike in adoption to the stage in diffusion when fitness around adaptation to (or adoption of) the innovation is emerging and self-sustaining. The flattening of this momentum represents the phase after the proverbial "tipping point" (citing Gladwell 2002). Critical mass has set in, leaving a diminishing stream of hold-outs or *laggards* as they accommodate the new system. In general, the flat adoption rates that precede and follow adoption spikes are likened by the authors to *attractor states* in CAS. In DIM, we can see these as stable periods of equilibrium as characterized by the old "normal" and the new "normal," respectively.

With regard to the heterogeneity required to spark bifurcation cascades, the authors assert that DIM has a lower threshold than CAS, a phenomenon Rogers et al. (2005) attribute to Granovetter's (1973) notion of the *strength of weak* ties. The idea that small changes can create big waves is actually fairly well documented in related research in dynamic systems (DST), a cousin to CAS that will be explored later on in this chapter. In both CAS and DIM, the authors acknowledge *strange attractors*, unexpected and scale-immune ripples from the micro- to macro-level, as individuals can affect the larger group and vice versa. Likewise, Vygotsky (1978) posited a strong, disproportionate connection between individual and collective cognition. The authors also attribute the lower threshold of variety in DIM to the notion of re-invention (Rogers 2003); to the extent that potential adopting systems mold an innovation to fit with its norms and practices, implementation is routinized and institutionalized. This is an especially important finding, given the particularly mediational nature of educational innovations.

A final CAS construct that the authors tie in with DIM is that of *feedback*, which in DIM is constituted by an innovation's "trialability" and "observability," alleged to be mutually reinforcing factors. To the extent that adopters in a system can test out

the innovation, they are more likely to be able to observe its benefits. Seen through the lens of social capital in educational organizational settings, successful, expert users of an innovation directly or indirectly exert pressure on colleagues who are less inclined to adopt. The adaptive nature of feedback also reinforces the move from linear to linkage models of educational innovation diffusion (Huberman 1983).

Offering the "Stop AIDS" campaign as a case study in a hybrid CAS/DIM model and the way innovations in DIM behave in a manner similar to strange attractors in a CAS, the authors demonstrate how big changes started with a method cultivated in a relatively small, localized heterogeneous zone (a San Francisco neighborhood) and spread. The method centered on information about HIV that culminated with a show-of-hands acknowledgement of the intention to practice safe sex and a commitment to leading an additional meeting. Criticality (CAS) or critical mass (DIM), the authors argue, was attained in the mid-1980s, once word spread regarding the success of the "Stop AIDS" model. After this initial spike in the "S-curve," eventual adoption was assured as larger-scale adaptations of the campaign were developed and disseminated in other major cities, ushering in the second spike as the strange attractor (innovation) was set on its course toward institutionalization, confirmed by the eventual drop in the spread of infection. Though the authors pass over it, the re-invention suggested in the second rise in the "S-curve" further emphasizes the importance linkage and meaning negotiation in fashioning innovations for a better fit with the adopting system.

2.7.2 Dynamic Systems Theory

Within the family of theories rooted in studies of complexity, Dynamic(al) Systems Theory (DST) serves as a cousin framework for CAS and lies at the root of the DIM/CAS notion of "basins of attraction" and "strange attractors." Dörnyei (2008, 2014), working from a Dynamic Systems Theory (DST) perspective, prefers to envision a beach with divots and "bumpy bits," but essentially the overall picture is the same across all three conceptions. Using DST as a base, Nicolescu and Petrescu (2013) assert that educational settings are a lot like an ecosystem, a *self-organizing system*, in which innovations may set a school culture into a state of disequilibrium by establishing a conflict between new and established information. They also call attention to the macro-shift from the Information to the Knowledge Age; it is no longer the information that is important, but rather, how one manages it. In the Knowledge Age, information is passed between complex (adaptive) systems in such a way that there is more permeability, the boundaries are "typically fuzzy" (p. 582), and the flow, dizzying. Consequently, the authors liken pedagogy to the ski jump, using the synergy between the ramp angle, the coach and the skier as metaphors for a dynamical subsystem consisting of the curriculum, the teacher and the student, respectively, the goal being to set the learner on the right trajectory toward an emergent future. Mathematically, this picture portrays a dynamic (not linear) process, one that depends on the dance of nonlinear differential equations

whose results must be observable, both in the mathematical sense, as well as in the sense of *observable* benefits of educational innovations.

Let us consider this dance from the standpoint of social capital. From a CAS perspective, one might hypothesize that social capital emerges not on the smooth, horizontal momentum of the "S"-shaped diffusion curve but rather in those moments of disequilibrium in the system, the vertical spots that reflect the spike imbued in early adopter use of the innovation and the second spike as diffusion hits the "critical mass," the point of no return, just before its confirmation is all but assured. This dynamic may explain Frank et al.'s (2004) findings that *comfort*, more so than "perceived potential or value," was pinpointed as a central concern for these teachers. It seems logical that the comfort concern would emerge during the turbulent upward spikes in the diffusion trajectory, when an otherwise steady state of equilibrium in the school culture is disrupted by a strange attractor that may need to be integrated in order to maintain its fitness as a complex *adaptive* system. Within a DST framework, Nicolescu and Petrescu (2013) conceive of this as an ongoing calibration of the ski jump's slope. As a dance metaphor, CAS has more of the tension and drama of the tango, whereas DST connotes a supportive sort of give and take encountered in traditional square or contra dancing. Perhaps there is a need for both conflict and comfort in the dance of educational innovation diffusion?

In some ways, comfort in educational change may present a peculiar hybrid zone of *connected growers*, which, in DST, denotes interconnections in subsystems that support one another when resources are limited. What is true for an organism or ecosystem resonates with the hard-pressed situation of most K-12 teachers. This collegiality need not be strained by the toxic pressures of social capital depicted in Frank et al. (2004) study. Deci and Ryan (2000) draw distinctions between introjected regulation and the most self-determined form of extrinsic motivation, integrated regulation; there is something adaptive and inherently virtuous in the capacity to take in new ways of interpreting and constructing meaning. Whether we engage with strange attractors of an introjected or integrated variety, there certainly, as Rogers et al. (2005) suggest, may be profit in cultivating and sustaining heterophilous networks of educators and stakeholders in educational innovation diffusion. Such crossings, in fact, are and have always been inevitable in our evolution, beginning with our first ventures into a mediated relationship with the natural world out of which all cultures developed.

2.8 Discussion and Suggested Directions for Future Research

A common theme that emerges in recent studies is a potential binary aspect in educational innovation diffusion. The reader will recall Tarde's (1903) emphasis on conflict as a catalyst for inventions. Conflict thrives on tensions, and in the diffusion of educational innovations, there certainly seems to be no shortage of such conflict. Conflict needs two sides, and there is certainly a "binary" or "bundled" aspect within diffusion variables, including compatibility and relative advantage, in Karasavvidis (2009), and flexibility and observability in Rogers et al. (2005). In

my own work as a participant in the development and dissemination of online learning policy and pedagogy, such polarities have been common, and they seem to resist efforts to find middle ground or a tempering of absolutist positions. On the surface, one may simply wait for the "laggards" to retire or surrender. This temporal dynamic is favored in Rogers et al. 2005 particular blend of DIM and CAS. CAS's bifurcation cascades, triggered by the intrusion of an innovation, suggested an inevitable counterattack of the "old ways" that spike the diffusion rate, eventually ensuring full adoption and implementation. Let us also remember, returning to Tarde and Mort, indeed, even in Rogers' classic DIM model, that some measure of adaptation (re-invention) within the developing system is necessary to "find fit" between established practices and new ways imbued in the innovation; this is not so much a matter of time as it is the relative possibility of working into a new phase state, given the particular blending of often very disparate systems. As Sidorkin has suggested in this volume, active crafting and negotiating on the part of teachers and students is essential, and not all innovations may count on the sanction of such stakeholders. Let us affirm this as the virtue of educational *adaptation*.

To blend innovation and adaptation in the study of educational change, Jung and Kirton offer some guidance. Borrowing from Jung's (1967) application of alchemy to psychological development, we might think of this tension as the adaptation-innovation *coniunctio*. Jung posited that it is the destiny of all living things to individuate, confront, and temper polarities, a point that I used to offer some calm in the calamity surrounding the diffusion of online learning (Warford 2014). Perhaps Kirton (2003), on an organizational psychological level, was aware of the need for this synthesis and balance in the workplace in positing his adaption-innovation continuum. Within CAS, such blending attains "a higher-order, fitter system" (Rogers et al., p. 4) that optimizes the best of the tried and true and the new.

Expansive thinking is particularly important in educational settings if we accept that innovation is ultimately in the "eye of the beholder." Reclaiming the origins of diffusion research, our attention should not be so myopically focused on the innovation but instead centered on how innovations are *adapted* in educational systems; we need to embrace adaptation as this "strange attractor" imbued in the implementation of educational innovations. If one really listens to all of the emergent paradigms in the study of educational change and the professional development staff of a particular school district, then it is no longer acceptable to speak of adoption at all; there is no simple transference from point A to point B; all ideas and technologies in educational settings are *adapted*. Adaption may prove itself to be the central focus of educational change, at least with regard to research approaches in this area.

From bird migration patterns to AIDS education campaigns, complexity has finally left its mark on innovation. Innovation, with its worn-out unilateral exaltation of old over new, innovator over laggard, velocity over volition, has come face to face with this orbiting strange attractor that has revealed itself as adaptation. Adaptation will not tolerate the sort of polarized thinking that pervades research on educational innovation. Fixed categories will not suffice. Thanks to factor analytical studies and complexity theory, we now know that variables like innovation

characteristics do not exist in isolation; they interconnect, subordinate, and localize in such a way that we should not be surprised if we discover that adaptation emerges as the originating principle that moderates and mediates all other characteristics. With regard to stakeholders in educational innovation diffusion, we should neither be surprised to find that it is teachers and students who are the true innovators, fashioning the most worthy innovations and that the so-called purveyors of policy innovations, driven by the bottom line and the aggregation model of doing business, emerge as the laggards. Back in the 1960s, Rogers and Jain (1968) warned that "diffusion research has largely been on the side of the sources, not the receivers of education diffusion" (p. 1). What does that mean? In the diffusion of educational innovations, it is felt in the exponential increase in the number and sheer velocity of questionable "innovations" hoisted onto hapless schools; the adaptive process of finding fit is for all intents and purposes bypassed.

2.9 Conclusion: From DIEM to DEAM

Several years ago I acted upon the misfortunate assumption that I could enjoy a few ears of corn from a farm adjacent to my house. This was not the sort of corn I was accustomed to finding in the supermarket; it was at least 25% bigger and the kernels somewhat gnarly in appearance. In spite of heaping condiments like butter and salt on this monstrosity, I can assure you this strange new "Frankencorn" was not fit for consumption—by animal or human. There is something both empirically and metaphorically significant to take from this experience, which returns us to the modern origins of diffusion research, to that original hybrid seed corn designed to maximize crop yields. The velocity and variety of edible innovations, much like the educational innovations of our time, have yielded mutant products borne of a business model that favors aggregation over differentiation; respectively, edible and educational innovations (i.e., "best practices") have been rendered indigestible.

Fortunately, the confrontation with complexity has led us into something organic, rhizomic, emergent, perhaps even convergent and spiral-like, nourished by mediation and hybrid encounters between innovators and laggards, researchers and teachers, East and West, and quantitative and qualitative approaches. Such heterogeneous zones necessarily subvert the traditional linear model of antecedent-process-consequences originally advanced in the classic DIM and the DIEM I proposed a decade ago. The arrows now point in all directions and the boundaries are starting to blur. For example, if we accept that the study of (educational) innovation diffusion has a history of bias in favor of the purveyor side (Campbell 2015; Rogers 2003; Rogers and Jain 1968; Warford 2005), then clearly we need to consider more carefully just *who is* the adopter-receiver? Given the growing influence of policy mandates from the state to national level, adoption could not be more beyond the control of teachers and administrators, or for that matter, entire school districts or universities. This increasing macro-level focus is perhaps enabled by the persistent lack of attention to sociocultural realities of adoption in educational settings, both internal (Henrichsen 1989; Tang et al. 2015; Warford 2014)

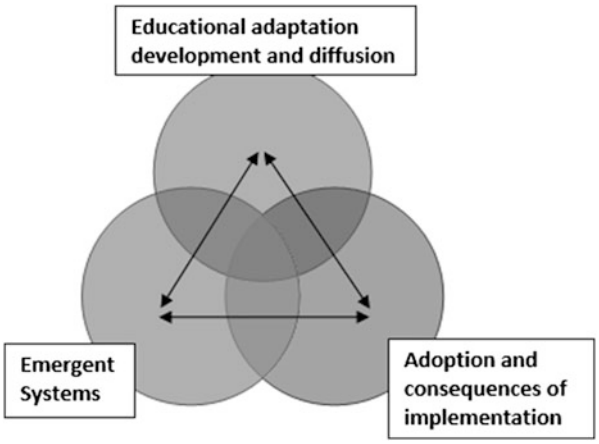

Fig. 2.1 Diffusion of Educational Adaptations Model (DEAM)

and external (Fullan 2007). Given strains on adopting educational systems noted here, one wonders if this titanic march of forced change will not eventually meet its tipping point.

In his chapter, Ellis invoked the biblical origins of what has become a common saying among teachers in the USA: "nothing new under the sun." What on the surface appears to be a commonplace cliché has underlined a subversive challenge to innovation's very existence. One must accept that there is no innovation that is new in the purest sense; all creations of cultures carry complex, adapted systems of meaning spanning back eons. Consequently, the DIEM has given way to a DEAM (Diffusion of Educational Adaptations Model) (Fig. 2.1), that features the permeability afforded by the principle of adaptation, now freed of the temporal, linear path of the classic innovation diffusion model. The DEAM has made some replacements for the three core categories of variables in the Rogers' DIM. Rather than antecedent variables, the focus is on interlocking, emergent systems that, in alignment to CAS and Activity Theory, subordinate to one another and are constantly in flux. Rather than wasting time with the dubious pursuit of pinpointing adoption in the diffusion process, the focus is on the innovation development and diffusion process, which optimally should be permeable to research on the stakeholder systems and feedback from users of new pedagogies and technologies *before* they are disseminated. Consequently, "consequences" represent not the end of the line but rather components of a three-way iterative process that recognizes (1) that the use of educational adaptations constitutes the dynamic nature of educational systems and (2) the ongoing re-invention of the adaptation informs the emergence of the said adaptation, like the interlocking trefoil depicted in Huberman's Linkage Model (1983), movement between the components of the adaptation process in multiple directions; however, if we really heed the message from CAS, the model may be expanded into three dimensions as the various components influence one another's growth: rather than a cycle, we may conceive this as "spiral-like" and constituted by a sort of living ecosystem in emergent, interlocking phase states.

There are many implications of this new way of portraying the complexities of educational change, and I hope that it offers a useful springboard for future studies in educational innovation diffusion.

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The Nature of Educational Innovation

3

Arthur K. Ellis

Never before in history has innovation offered promise of so much to so many in so short a time.

Bill Gates

Out of every ten innovations attempted, all very splendid, nine will end up in silliness.

Antonio Machado

Innovation and *novelty* come from the same Latin word, "novus." These words imply something new. The idea that something is new is dear to our hearts. We have been conditioned by advertisers and promoters to associate "new" with "improved," whether the product is laundry soap, a smart phone, or a school curriculum. The *Oxford English Dictionary* defines innovation as "the introduction of novelties." Innovation is a noun related to the verb "to innovate," first found in print in 1561 in Thomas Norton's book, *Calvin's Instructions,* in which Norton wrote, "a desire to innovate all things moveth troublesome men" (Calvin 1960). So this term innovation appears to have touched emotions, both positive and negative, from that time to this day.

The purpose of this chapter is to identify, define, explicate, and document certain educational innovations, some of which seem to have found a permanent niche as well as some that come and go. Beyond that, the reader is directed to certain high-profile centers of innovation around the world and to a description of how innovations diffuse from inception to widespread usage. Additionally, this chapter addresses the current state of two notable innovations, that of the phenomenal worldwide growth of Internet-based distance learning in higher education and the continued attempt to influence academic achievement in public schools through such federal interventions in the United States as *No Child Left Behind, Race to the Top*, and *Common Core*. A summary note raises questions of the intrinsic worth of

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certain innovations and the extent to which innovation and improvement are sometimes not the same thing.

The US Department of Education's Office of Innovation and Improvement (OII) offers the following descriptive definition of educational innovation, specifying three types of innovation: organizational/managerial, instructional/methodological, and professional (2016):

> In the world of education, innovation comes in many forms. There are innovations in the way educational systems are organized and managed, exemplified by charter schools or school accountability systems. There are innovations in instructional techniques or delivery systems, such as the use of new technologies in the classroom. There are innovations in the way teachers are recruited and prepared and compensated.

The *OSLO Manual* of the Organization of Economic and Cultural Development (OECD) describes four types of innovation: product, process, marketing, and organizational (2016). The manual addresses innovation more broadly than the sphere of education alone, but the literature and history of educational innovations is ripe with educational examples, for better or worse, of all four categories. A product could be anything from a blackboard to emerging wearable technologies. Education is filled with perhaps too many process innovations. The list includes cooperative learning, flipped classroom, inquiry and discovery teaching and learning, team teaching, and the list goes on. Marketing typically happens when commercial interests become involved. Currently, marketers vie for textbook adoptions, hardware and software adoptions by school districts, and workshops aimed at teacher in-service training in innovative methods or proper product usage. Organizational innovations are as monumental as the 1892 Committee of Ten Report (National Educational Association 1894) which called for a reorganization of the secondary school curriculum along standardized lines, one which would give parity to the sciences as school subjects, emphasize modern foreign languages, and include fifty minute periods of instruction. Others include the middle school (as opposed to the junior high school) as an innovation, year around schooling, and after-school inclusion of the extra curriculum, often in the form of athletic participation.

Taking these characteristics and attributes of educational innovation into account, it is useful to note that most of those considered "successful," in terms of influence and staying power, are in fact pedagogical innovations in the form of instructional methods and teaching/learning processes. OECD (2014, p. 1) notes that compared to other sectors, knowledge and method innovation is above average in education compared to other sectors, average with respect to technology innovation, and below average with respect to product and service innovation.

Pasi Salhberg, author of *Finnish Lessons: What Can the World Learn about Educational Change in Finland* (2015), cites five pedagogical educational innovations which are widely used in Finnish schools but which originated in America. They are John Dewey's (1938) progressive educational approach which emphasizes pragmatic experience; cooperative learning in which students work together on projects and activities (Johnson et al. 1988; Gardner's 1983); multiple

intelligences which invite a wide range of talents beyond those traditionally associated with school success, namely, linguistic and logical-mathematical; alternative assessments (Towles-Reeves and Muhomba 2009), particularly formative evaluation as assessment *for* growth; and peer coaching, made popular through the work of Showers and Joyce (1996). It is worth noting that although these celebrated innovations seem to work well in Finland, their points of origin in America where academic achievement remains mediocre at best serve as a reminder that any innovation resides in a deep cultural milieu of family and societal expectations and that it cannot of itself make a world of difference.

Whether an innovation finds a niche in the scheme of things can be a sometime thing. The overhead projector, an apparatus that may well be unfamiliar to the younger generation, was touted in the second half of the twentieth century as an indispensable apparatus in classrooms. Millions of overhead projectors were sold to schools. The idea was that the overhead projector allowed the teacher to face the class while presenting material that was illuminated on a screen. Critics pointed out its static nature which allowed only one slide at a time as well as its teacher-directed quality that made it mainly a tool for presenting material to passive learners. In time it was replaced by an older innovation, the chalk board, which allows a more dynamic, interactive pedagogical flow, especially in its twenty-first-century incarnation as the smart board (Cuban 2001).

Every innovation has a certain nature, that is, inherent characteristics that define it as a thing in itself. The flipped classroom, for example, is a simple technique that "frontloads" information for learners *prior* to instruction. The centuries-old idea that it is natural for students to come to class to listen to an instructor as he/she teaches a lesson with assignments to follow is turned on its head. Students view a podcast or read certain material before class, changing the nature of the time spent by students in class from that of reception learning to an experience in dialogue with the teacher and one another. To traditionalists, this may seem quite unnatural, and without doubt, the whole idea has touched emotions pro and con.

It is also the case that every innovation must be considered from a structural viewpoint. In fact, this in large measures the determinant of success or failure. An innovation may be good in itself, but in order for it to succeed, it must find its place as a structural element. Schools and classrooms are complex systems with interacting parts. Any given change means that something is replaced. When teachers are evaluated, typically someone in authority sits in the back of the classroom and makes notes on, among other things, the extent to which a class is under control. If the teacher is in the front of the room, standing up, and the students are seated at desks in rows, then this simple syntax makes it rather easy to determine whether students are compliant and seemingly attentive. But if a teacher elects to use cooperative learning, then the structure of the classroom changes from a more static to a more dynamic arrangement, making traditional elements of control more complicated. Whereas the frontal teaching mode tends to eliminate or at least diminish the need for social skills on the part of the students, a decentralized structure such as cooperative learning depends heavily on the need for student civility and self-direction.

Innovation is related, but not identical, to invention. An innovator is not necessarily an inventor. The US Patent Law defines invention as "a new, useful process, machine, improvement, etc., that did not exist previously and that is recognized as the product of some unique intuition or genius, as distinguished from ordinary mechanical skill or craftsmanship" (US Patent Law 2016). Therefore, an inventor or team of inventors brings to mind such inventions and inventors as the Wright Brothers (the airplane), Thomas Edison (light bulb, phonograph, etc.), or Stephanie Kwolek (Kevlar). Inventions can be as world-changing and intangible as calculus, invented separately by Isaac Newton and Gottfried Leibniz, or as immediately practical as windshield wipers, invented by Mary Anderson, or the Post-it note, invented by Arthur Fry. Johannes Gutenberg is credited with the "invention" of moveable type, which made the printing press possible. In fact, printing was an ancient process first developed in China. Its spread to the Western world was slow. Beyond that, Gutenberg was one of a number of printers whose work led in a collective sense to the print revolution, an invention that changed the world. The thing all these have in common is that something came into existence that did not previously exist.

An innovation, on the other hand, refers to the introduction of an existing process, program, or way of doing things that offers new capabilities to users. Early in the nineteenth century, a Scottish schoolmaster named James Pillans, a geography teacher at The Old School of Edinburgh (yes, there really was a place called Old School), attached a large piece of slate to the schoolroom wall. His idea was that when he, or perhaps his students, wrote on this "blackboard," the whole class could view whatever it displayed, all at the same time. Pillans realized that maps or charts hanging on the wall could be viewed by one and all and that the handheld piece of slate each student brought to class could be written on, erased, etc. (Buzbee 2014). In that sense, there was nothing new here. But the fact that a wall-mounted blackboard has a dynamic element (as opposed to the unchangeable static element of a wall-mounted map or chart) and can be seen by everyone present was indeed an educational innovation. His idea combined visibility with changeability, resulting in something new. Over time, slate changed to porcelain-baked enamel on pressed board, blackboards became green boards, and then white boards, chalk replaced slate and was itself replaced by felt markers, but the basic idea remains the same. In the 1960s a competitor innovation emerged in the form of the overhead projector. But its severe limitations were exposed in time, and the overhead projector was relegated to the dust bins of pedagogical history. Take an overhead projector into a primary classroom today as an artifact for young anthropologists to study. Can they figure out what it was used for? Today we have the smart board, a highly interactive incarnation of the blackboard, and no doubt continuous upgrades will be made, but the blackboard remains.

Innovation promises something new along with the implication of something better. The innovative processes of electrification changed everything. The night world became light. Food could be refrigerated and kept from spoiling. Factories could operate on electrical current rather than steam power. Portable batteries could be used to start automobiles. Radio and television became possible.

In the world of education, from primary through tertiary, innovation seems to be all-important. Schools and teachers want to be on the leading edge, to know the latest trend, and to avoid being old-fashioned or possibly out of date. Keeping up is crucial. No one wants to be left behind. Perhaps the most visible innovation that schools at all levels have had to take into account is the personal computer and its outlet, the Internet and World Wide Web. These innovations are so profound that the extent to which they have and will change access to knowledge remains uncertain. One result of these innovations is the sudden appearance, like mushrooms after a spring rain, of online virtual universities and the exponential growth of online education.

3.1 Types of Innovation

What do we mean by the term innovation? How is innovation different from invention or improvement? Invention refers to the creation of a new product, idea, or method itself. Innovation refers to the *application* of a better product, idea, or method. Invention and innovation are both disruptive. That is, they bring about dramatic change that represents a break from past and present. As MIT Professor Seymour Papert once noted that when computers are brought into the classroom, everything changes (Papert 1987). The computer represents an invention, and certain novel applications of computers in education represent innovation. Improvement, on the other hand, differs from innovation in that it is typically gradual and mainly designed to modify existing structures rather than change them altogether.

An educational innovation need not be a new idea in itself; rather, it often represents an insight on the part of a person or persons who devise a novel application for a preexistent idea. The "project method" in school learning represents such an example. European university students studying art and architecture have, at least since the eighteenth century, been required to create or construct projects that exemplified their growth and development toward mastery. Such projects were typically capstone or valedictory projects following a course of study. Working at Columbia University early in the twentieth century, Professor William H. Kilpatrick published his ideas for the project method to be utilized in school settings. He advocated project learning as an active learning counterpoint to the passive read and write, drill and practice methods so common in American education at the time. His article in a 1918 edition of *The Teachers College Record* attracted an astounding level of interest among teachers and administrators across the country with more than 100,000 requests for reprints (Kilpatrick 1918). *The Teachers College Record* was certainly a high-profile prestigious journal, but the diffusion of this idea, which remains popular to this day, was accomplished largely by word of mouth. This innovation's power was based on the persuasive idea that students can learn by doing, through construction and through working together.

3.2 Centers of Innovation

Today innovation is a magic word in education, business, and in the arts and sciences in general. One need only Google the term to see how ubiquitous it is. Innovation has in fact become institutionalized. Centers of educational innovation abound. We can expect even more of them to develop worldwide. Permit me to cite five such centers, ones that have a high profile and which clearly focus on concrete steps to be taken in the name of innovation.

The Center for Education Innovation (educationinnovations.org) is a non-state organization funded by a number of foundations including Cambridge Education, Aga Khan Development Network, UNICEF, OECD, and Deshpande Foundation of India. Its outreach is worldwide with a focus on educational technologies, low-cost private schools, teacher quality, and school improvement from primary through tertiary levels.

ExxonMobil Perspectives (exxonmobil.com) is a foundation supported by the petroleum giant and which focuses primarily on funding for research and development in the areas of mathematics and science education. The foundation sponsors the National Mathematics and Science Initiative, designed to bring innovations to teaching and learning in these content areas in American schools. Of course, science and mathematics loom large on the American school agenda, fueled by fears that the United States is falling behind in achievement in these areas. The STEM initiative (Science, Technology, Engineering, and Mathematics) in which nearly every university now participates in STEM teacher training underscores the strategic importance of these subject areas.

The Office of Innovation and Improvement (ed.gov), a department of the US Department of Education, focuses on support for initiatives in a wide range of topics including teacher quality, charter schools, arts in education, principal and school leadership, and university museums, to name a few.

The Center for Entrepreneurship & Innovation (iie.org) of the Institute of International Education sponsors research and development for new ideas in economic growth, leadership and human capacity, and vision. The Center is administered by the US Department of State and is a player in the well-known Fulbright Foundation.

Educational Innovation, a Center located at the University of Wisconsin Madison Campus. The Center's mission is to empower faculty and staff to be agents of change and innovation to transform, engage, and inspire students and empower communities. The Center includes all facets of the University including economics, agriculture, sciences, arts, etc.

These centers are merely illustrative of the hundreds of centers of educational innovation located around the world. Innovation is indeed a catchword of our times. What person or institution doesn't want to be considered innovative? A given innovation, however, may be "good" in itself, but how do others learn about it? And when they learn about it, how do they implement it faithfully? Centers such as

those just cited act as collector/distributors of innovation. They provide infrastructure and support through research findings and means of diffusion. It may have been the case that Kilpatrick's project method innovation spread largely by word of mouth, but such current-day innovations as cooperative learning and problem-based learning find support in the form of research articles published in refereed journals, how-to articles published by professional associations such as ASCD, presentations are regional and national conventions, and workshops offered to school districts by gurus who tout a particular way of implementing an innovation with fidelity.

3.3 Diffusion of Innovations

A particular innovation is one thing. The extent to which it finds favor and is adopted is quite another. One of the pioneers in the study of the diffusion of innovations, that is, the study of how innovations spread, was Everett Rogers, an American social scientist whose specialty was rural sociology. Rogers was able to demonstrate why certain innovations spread and are sustained and why others do not. In his book *Diffusion of Innovations*, Rogers (1983, 2003) lists five characteristics to consider with regard to any innovation:

1. **Relative Advantage**, the degree to which an idea is perceived as better than the idea it supersedes
2. **Compatibility**, that is, the degree to which it seems consistent with existing values, past experience, and needs of potential adopters
3. **Complexity,** which is the degree to which an innovation seems difficult to understand and use
4. **Trialability,** the degree to which a new idea may be experimented with on a limited basis
5. **Observability**, that is, the degree to which the results of an innovation are visible to others

How and why do certain innovations diffuse successfully? What causes others to die on the vine? The level of success an innovation achieves represents an effect. Therefore, it is reasonable to search for causation although direct cause and effect relationships in this regard are not always easy to determine. In some cases, the cause may be external to the simple idea that the innovation itself caused its own spread. This is true of the innovations of the 1960s, for example, the New Science and New Math, which were based largely on process approaches such as problem solving, higher level thinking skills, and the very idea that students should behave as scientists and mathematicians, exploring ideas, documenting findings, explaining proofs, etc. The external cause was the launch by the USSR in the autumn of 1957 of the Sputnik, the Earth's first artificial moon, placed in orbit by Soviet scientists. This event shocked people at all levels in the United States, and the blame for America's failure to be first in space was leveled at the schools. The curriculum was

too "soft"; school was more carnival than learning laboratory. Congress allocated large sums of money to fund curriculum projects that could bring rigor and discipline to the teaching of science and mathematics in particular. Of course, the space race was a proxy for military strength, so this external threat actually served to bring many excellent innovative programs to the schools. Unfortunately, these programs, in spite of their excellence, did not receive proper infrastructure support, and most of them gradually disappeared. This was a lesson learned in the successful diffusion of innovations. It is not enough to have a good product or method. It will not and cannot succeed without support systems. This story of innovation diffusion failure is well told by Hargreaves and Shirley (2012) in their book, *The Global Fourth Way*.

3.4 Innovation and the Standards Movement

With the publication by the US National Commission on Excellence in Education of the *Nation at Risk* report (Gardner, et.al. 1983), the motivation to innovate was once again an external threat, this time in the form of Japanese economic competitiveness. Americans were buying such Japanese products as cameras, automobiles, computers, and television sets to the point that American jobs were being lost, and companies were going bankrupt. The rise of other Asian Tigers and ultimately of China further fueled the argument that the United States was falling behind in a time of economic globalization. This, coupled with the dismal results America has achieved in PISA and other international tests, has led over the past 30 years to a demand for subject matter standards, a more rigorous curriculum, better teaching methods, and standardized examinations to measure academic gains.

Whether this attempt at innovation will prove to be more helpful than harmful to education remains to be seen, but I myself am skeptical. One difference in these two externally derived attempts to innovate is that although the Sputnik era did represent federal funding at the levels of curriculum development and teacher training, it was not nearly as top-down at the *Nation at Risk* movement. For the past 14 years, the federal government, both executive and legislative branches, has imposed conditions, complete with purse strings, on schools in the form of "No Child Left Behind" (NCLB) legislation under President George W. Bush and "Race to the Top" (RTTP) and "Every Student Succeeds Act" (ESSA) legislation under President Barak Obama. Top-down edicts rarely succeed in organizations. (US Department of Education 2016).

3.5 The Success and Failure of Emergent Alternatives

An alternative to attempts to diffuse innovation through external threat and/or top-down edict, is the so-called grassroots effect in which innovations take hold largely through word of mouth and widespread support among the rank and file of an organization, for example, teachers and administrators, students, and parents. To

be sure, grassroots enthusiasm without proper theoretical and empirical foundations has not been sufficient to sustain certain innovations. One such innovation, called Instructional Theory into Practice (ITIP), swept the country during the period of the 1970s through the mid-1990s (Hunter 1976). ITIP was reckoned to be the most widely adopted innovation in modern American school history (Slavin 1989). The protocols of this method of teaching and learning involved eight "steps in effective instruction." The steps formed a template for lesson plans but also for evaluating teachers. Teachers were hired on the basis of the knowledge of the steps. Schools of education in universities and teacher training institutions taught the ITIP approach to per-service teachers. Workshops and courses were held for in-service training as well. But in 1989, Robert Slavin, of Johns Hopkins University, produced evidence in an article in the journal *Phi Delta Kappan,* that showed that ITIP was little more than a superficial mélange of psychological theories which had not been tested when put together into the ITIP format (Slavin 1989). Empirical research was almost completely lacking. It was a situation reminiscent of *The Emperor's New Clothes*. There was no evidence of its positive academic effects, but no one had really challenged it until Slavin came along. As a result of Slavin's article, ITIP melted away like snow in a warm spring rain. Today, most younger teachers have never heard of it. Still, as innovations go, it began on a small scale with regional workshops and scaled up remarkably. Whatever we might think about this approach, it was indeed well diffused.

Why some innovations wither on the vine while others scale up successfully is a question not easily answered. In education, we can ask whether an innovation, perhaps one that is shown to be efficacious in experimental or quasi experimental studies, offers the potential for widespread diffusion. Instructor feedback, for example, has been shown in numerous controlled studies to increase academic performance by students (Walberg 1984; Hattie 2012), yet there is little evidence that it is routinely found and systematically applied in classrooms. One can speculate on its lack of scalability, perhaps because it is seen by teachers as yet one more task in an already overburdened workload.

3.6 Disruptive Innovation

An innovation in higher education that shows considerable evidence of scalability is that of online learning. Advocates of online learning point to its relatively modest tuition structures, its appeal to nontraditional students across age groups, and its outreach to students around the world. Online learning in higher education fits the profile of what Clayton Christensen describes as a "disruptive innovation." The term "paradigm shift," coined decades ago by Thomas Kuhn (1962), comes to mind. Kuhn described a paradigm shift as a discontinuity or disruption in the linear progress of development which is thought to take place cumulatively and gradually. The introduction and widespread use of the printing press changed ideas of literacy and access to knowledge once and for all. It disrupted centuries of limited access to

books and made possible the Reformation among other things. It allowed ordinary people to become their own teachers.

At Southern New Hampshire University, in the United States, the on-campus student population is slightly less than 3000 students. But online enrollment as of 2014 was roughly 32,000 students (Huffington Post 2014). Universities such as Stanford have instituted MOOCS (Massive Open Online Courses) that enroll as many as 100,000 students around the world. In 2013 Harvard and MIT created a joint venture called EdX. EdX is a consortium of universities including UC Berkeley, University of Texas, University of Toronto, University of Kyoto, Japan, and others. EdX delivers MOOCS to huge audiences around the world. Coursera (see coursera.org), a rival venture developed by Yale, Duke, Stanford, and the University of Wisconsin, enrolls huge numbers with 74% of students outside the United States. Nearly every institution of higher learning in the United States offers online learning from individual courses to entire degree completion programs. So we have a phenomenon in the form of a disruptive innovation that has grown from nonexistent 10 years ago to enrollments in the hundreds of thousands today. Kathleen Ives, CEO of the Online Learning Consortium, notes that "the trend of increasing distance learning enrollment in the face of declining overall higher education enrollments suggests an important shift in the American higher education landscape" (Allen, Seaman 2016).

Beyond the sheer prestige of the world-class universities that sponsor MOOCs, four factors will account for the continued success of this diffusion: (1) price difference, (2) product quality, (3) international markets, and (4) traditional-age university students. At this point, two of these appear to have been achieved, that of cheaper prices of online courses compared to campus-based courses and the huge interest displayed by international students. One can cite online teaching and learning (using the example of MOOCs) as an example of a controversial theory known as "disruptive innovation." Thomas Samuel Kuhn introduced the world to the term "paradigm shift" in his celebrated book (Kuhn 1962). As we all know by now, a paradigm shift represents a disruption in the linear progress of knowledge by which advances are typically made gradually and cumulatively. Two world-class examples of scientific innovations that qualify as true paradigm shifts are the printing press and the internal combustion engine. They changed everything. Christopher Columbus' voyage to the New World in 1492 is an example in the annals of discovery. Whatever one might think about the positive and negative effects of his explorations, there was the world before Columbus and the world after Columbus. The term paradigm shift is no doubt overused, so I will limit my examples of educational innovation to more modest terminology. Nevertheless, I will offer two examples of change and innovation that offer constructive disruption to our field of education.

Disruptive innovation theory represents the work of Richard Foster (Foster 1986) and that of Clayton Christensen (*The Innovator's Dilemma* 2016). Christensen, a Professor of business at Harvard, explains that the opportunity for disruptive innovation in a system occurs when the system is, or appears to be, meeting the needs of many while a significant number of others are not having their

needs met. Disruptive innovation is typically characterized by a cheaper, seemingly inferior (Clayton 1997) product compared to that which is currently offered. Henry Ford recognized this need for a disruptive innovation when he mass-produced the Model T automobile at a price that ordinary people could afford. To be sure, cars were being sold to wealthy people, but Ford saw an opportunity to expand the market by offering a cheaper product of lesser quality but still adequate to meet certain needs and wants.

In the case of feedback/formative assessment as a pedagogical tool, the conventional wisdom in American education from the mid-1980s to the present day has been that high-stakes summative standardized testing is the best route to reform. The idea is that if students and teachers are held accountable for student learning, academic gains will surely follow. There is some evidence that this is working, but it is surely not working for all students. This top-down movement has inadvertently given rise to a corollary phenomenon, that is, the rise of low-impact, cost-free, formative assessment in which students reflect on what they are learning in the form of simple written "I learned" statements which students write and submit at the end of a lesson and which are marked by the teacher and returned to the student. Solid evidence exists that this results in higher achievement (Black and William 2010).

Computers entered education in the 1980s accompanied by the promise that this would raise achievement and transform classrooms. Similar hopes had been raised and then dashed regarding the potential of radio and television and film to change school learning. In spite of the huge sums of money spent on desktops, notebooks, and handheld mobile devices, there is not much evidence that this innovation has improved learning as measured by test scores. The problem ultimately is not that these devices get in the way of learning. Rather, the problem seems to be that they are not suited to traditional classroom- and school-based teaching and learning. Enter online learning. The criticisms of online learning coming from traditionalists have been many and in some cases valid, for example, the loss and absence of human contact and interaction, of a motivating force in the form of a teacher, of the esprit de corps that develops in a class of students, and of the low completion rates of online courses by students. But the advantages of online learning include cheaper costs for delivery, flexible times when a student may choose to learn, and the convenience of not having to attend a school where many students simply do not feel comfortable or even welcome. It is popular to cite the obvious drawbacks of online learning, just as people could cite the drawbacks of the automobile compared to horse-drawn transportation early in the twentieth century: bad roads, engine failures, flat tires, inadequate numbers of petrol stations, etc. Online learning will need to improve in order to become viable and sustaining. Already, hybrid forms, known as blended classes and flipped classes, are becoming common, getting us beyond the either/or stage. Online enrollment was approximately 45,000 in the year 2000. Today it numbers nearly 7 million students and is growing rapidly. In 2016, it was calculated that 28% of students in higher education are enrolled in at least one online course Allen & Seaman, 2016. The numbers continue to grow.

Today more than 77% of university administrators express a favorable attitude toward online learning, according to a 2012 poll taken by the Babson Research Group and the Sloan Consortium. This is a change from 57% who responded to the same poll in 2003. The Babson Group (2016) reported a 3.9% enrollment jump from 2014 to 2015. Administrators continue to voice two concerns about this innovation: (1) the need for more self-discipline on the part of students and (2) low retention rates. However, a US Department of Education (Aud 2010)-sponsored meta-analysis of experimental and quasi experimental control group studies found that "on average, students in online learning conditions performed modestly better than those receiving face-to-face instruction." Beyond that, even better performance was evidenced by students involved in blended courses. This finding advances the argument that an "either/or" situation is less favorable than a mix of online and face-to-face teaching and learning.

Taking into consideration Rogers' five factor innovations diffusion model, MOOCs and other forms of distance learning appear to fare rather well. Their relative advantage includes cost which ranges from no cost or lesser costs to flexibility with respect to learner-determined access. They meet the flexibility requirement far more than do time and place determined courses, an especially important criterion for working people who may have no time for classes during the day. Complexity of use is greatly diminished since all one needs is a computer with Internet access. With regard to trialability, MOOCs offer the ultimate in course shopping with little to lose if one decides not to complete a given class and with hundreds of MOOCs from which to choose on almost any topic. The observability component is made readily available through numerous search engines from high-profile Google to a myriad of less well-known outlets. Prestigious universities including Stanford, Harvard, and Oxford use MOOCs as part of their branding outreach, creating high institutional visibility thus countering the perception that these schools are places reserved only for the wealthy few. In all, MOOCs and other forms of distance learning meet Christensen's disruptive innovation requirements in the sense they have resuscitated an old idea, correspondence course learning, thanks to new technological developments.

3.7 Conclusion

It can be argued that we are learning more about what works effectively as well as what does not, but there are many contingencies. We never "prove" anything in "soft" social science research, but we do build a case for support or lack of support over time. Innovations come and go. More often than not, they fade away in spite of the early promises made by their promoters. Increasingly, we are learning ways to test their effectiveness, and this enables us to make evidenced-based arguments. However, there will always be cultural factors of likes and dislikes, ease of implementation, teacher training, and, of course, cost. A prominent example of an innovation that was highly touted by its developers and promoters was that of learning styles. This innovation promised higher achievement and student

satisfaction if students' learning styles were diagnosed (Kolb 1976). The various categories into which the inventory placed student included auditory learners, visual learners, tactile learners, and kinesthetic learners, to name a few. This innovation promised a sound theoretical basis as well as one validated through empirical studies. However, the evidence was not particularly compelling, and teachers who face perhaps 25–150 students per day hardly knew what to do in order to meet the range of styles. As a result, learning styles have nearly disappeared from the American educational scene. One could speculate on the reasons for the demise of the learning styles phenomenon, and a reasonable place to start is with Rogers' five characteristics of successful innovations, especially complexity of implementation and compatibility with existing school curricula.

Determining "what works" obviously implies a pragmatic approach to the value of an innovation, but it also suggests the question: "what works for whom?" Currently in the United States, a phenomenon known as "value-added" assessment is in vogue. Value-added assessment ties student academic performance as measured by standardized tests in mathematics, literacy, and science to teacher influence. We could ask ourselves, why shouldn't teachers be held accountable for the achievements of their students? However, when we examine John Hattie's (2012) list of effect sizes we find that television yields an effect size of negative 0.18 and student mobility an effect size of negative 0.34. American students watch a great deal of television, and when time is spent by students playing video games is added, we can see that school has a very real competitor. With regard to mobility, the Annual Social and Economic 2004 Supplement to the US Census found that 15–20% of American students moved in the previous year.

A deeper question of "other directedness" arises when we ask ourselves "what works?" If the calculation of what works is found in test scores, then we are in the position of yielding the ultimate measure of education to test makers and those companies, like the Educational Testing Service (ETS) and Pearson Publishing, two giant corporations who make millions of dollars on the sale of their tests to schools. We have a saying, "what gets measured is what counts." Where are the measures of citizenship, self-realization, student and teacher empowerment, team building, and happiness? Are these not important? Do they not count as part of a person's education?

Finally, one thing is certain: the promises of innovations will continue to be made by those who develop and promote them. Surely the pace at which educational innovations appear will increase. This will underscore the need for critical appraisal on the part of those who are expected to consider and possibly adopt any particular innovation. The process of education is complex and always situated in a certain context. What works well in one context may not in another. The elusive quest to perfect a science of education where experiment, replication, and implementation follow logically in a pattern is problematic at best. Conclusions are bound by time and space and culture, none of which is the same from setting to setting. We cite probability, not proof, when we make inferences about the outcomes of even the most well-controlled experimental study. Paradoxically, the better a study is controlled, the less it resembles the messy chaotic world of

classrooms. But as we continue to benefit from brain function research and neuroscience studies, from cognitive science research that delves into factors of motivation, self-regulation, and goal setting, from developments in technologies that expand access to information in ways that seemed unimaginable only a few years ago, and from studies in organizational and human resources sciences, the promise of advancement does seem real.

The word "school" comes from the Greek word "schola." It originally meant an educational world view or set of ideas about what is important in teaching and learning. Over time, the word school came to signify a place of bricks and mortar, a building or set of buildings in a certain location. It became a place to which you had to go in order to learn important things. The great promise of recent educational innovations is that we now are given another opportunity to reconsider thoughtfully the ancient meaning of school.

> Daring ideas are like chessmen moved forward; they may be beaten, but they may start a winning game. Johann Wolfgang von Goethe

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People Matters: Innovations in Institutionally Weak Contexts

4

Peter A. Safronov

4.1 Change and Innovation: Contested Conceptions

Reforms are an ever-present part of educational policy across the world (Cuban 1990). Yet even in this ever turbulent context, the 1980s stand out in terms of massive government and public disillusionment with education in various parts of the world. *Nation at Risk* report of 1983 in the USA as well as *Education Reform Act* of 1988 in the UK are but a few examples of an overall criticism of schools' capacity to provide better lives for their graduates, which spread over English-speaking countries at the time in the 1990s; these debates, together with the growing influence of international organizations including World Bank (Heyneman 2003), delineated a whole stream of research literature, including Fullan's influential works on educational change (Fullan 1999, 2001). Fullan embraced the reform process in education as a policy or a set of policies that follow orderly stages from initiation to implementation and, later on, institutionalization (2001). What this conception apparently requires is an implied bedrock of common ideas and norms, as well as a shared knowledge of basic rules of social interactions, i.e., social institutions (Waks 2007, p. 285). Fundamental changes would not have been ever possible had they not been preceded or reinforced by the transformation of values. For this transformation to occur, a public arena, where various arguments might circulate, has to be in place since a commonality of norms or their difference reveals itself through open debate. Those arguments are usually accumulated by collective entities standing for a group of individuals sharing a common national, professional, or class identity. A network of collective stakeholders makes public debate possible and even inevitable. Yet we have to admit that connection of institutions and civic organization is not an inherent product of human history. Shared norms

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might be acquired and actually are acquired by various means. Henceforth I use the term "institution" to refer to a particular body of shared norms, rules, and viewpoints that arise from a variety of contexts. I use the term *institutionally weak context* to refer to such context where the existence of institutions is a subject of suspension or outright neglect. Under such circumstances no fundamental change in Waks's terms could happen since there is no any common set of norms shared across society to benchmark transformation. Moreover, it is precisely this subversion of common norms and ideals which was most eagerly sought after by the citizens of the late USSR. Paradoxically, the outburst of political activity during Perestroika entailed unforeseen decline of civic bonds with almost no nongovernmental organization (NGO) to stand up alongside the state in the public eye. In the field of educational policy campaigning for "humanization," which presumed respectfulness toward students' personality, rapidly swept the pendulum of reform too far away from "a common sense of citizenship" (World Bank 1995, p. xv). Although the obvious demise of public and political spheres after the collapse of the Soviet Union, the weakness of civic institutions was very much a product of radical individualism that flourished during and after Perestroika (Prozorov 2009). Social activities evolved around a highly selective process of creating one's own private public out of small number of entrusted friends that took shape already in 1970s (Yurchak 2006) and survived easily after the collapse of the USSR. The Soviet pedagogical Innovation Movement represented one of the clearest instances of this privatization of public sphere. The merging of pedagogical innovations with active promotion of such privatized publicity has had dramatic effect on the movement's sustainability, diminishing its capacity to bring systemic change into the secondary education in post-Soviet Russia. Our theoretical question is whether subjective implications of innovative processes largely dominated their diffusion within the institutionally weak context of late Soviet socialism and the new Russia of 1990s and why that happened. This *subjectification* of innovations was first detected through close reading of research philosophical and/or (auto)biographical accounts produced by members of the Innovation Movement of the time and afterward (Kasprzhak 1992; Schedrovitsky 1993; Dneprov 2006, p. 79; Nemtsev 2006; Pinsky 2007, p. 139). Since all of them unanimously emphasized paramount importance of freedom as a primary condition of pedagogical innovation, the task of my own research was to pinpoint this constellation against the background of a comparative historical account of the two superpowers' educational innovation policies after 1945 and analyze interviews with the former members of innovative movement, periodicals, and archival materials.

4.2 Mining Meanings: A Note on Method

It might be reasonably argued whether retrospective accounts of the past could stand as actual facts referencing real events. A step into the controversial arena of meanings implies the researcher's involvement in intensive conversations with witnesses of events researched. The other person could not be dismissed as a

mere informant but rather insinuated as a collaborator or a field counterpart (Kvale 1996). That said we aspire to generalization of the contents of interviews in order to represent the discursive landscape as a whole (Silverman 2013; Yin 2009). For such a generalization to be possible, the researcher has to open up at first to the colloquial contingences or even direct attempts to impact his or her assumptions and conclusions. There is a certain challenge to accepted research conventions when interview is de-instrumentalized and turned into a field of outright improvisation (Holstein and Gubrium 1995). Yet it seems that this improvisational character of interviews was perfectly suited to the unveiling of human attitudes in all their complexity. Past and present are not poles apart, their boundary being constantly shifted through discursive interventions (Brown 2006). The generalizations produced should not, of course, be treated as one-size-fits-all statements on the essence of innovations as such. Their validity is bound to a certain temporal and spatial context and is assessed against the background of data retrieved from archival search as well as close examination of periodicals and other sources. From January 2015 to April 2016, 37 in-depth semi-structured interviews of approximately an hour and a half length each were conducted by the author and graduate students Ksenia Sidorova and Artyom Kulakov to whom I am very thankful for their participation and assistance. The sample was constructed via snowball technique (Babbie 2001), starting with personal acquaintances of the author who are former members of innovative movement. We also reached a number of school teachers who were professionally active at the given period although had not been involved in any close cooperation with innovators movement. Several interviews were conducted with experts from abroad who frequently attended Russia in the late 1980s and/or 1990s as researchers and experts of international organizations. Three informants provided written answers on the questionnaire compiled by the author in line with the structure of the interview guide. All collocutors either signed an informed consent form or granted their agreement on citing their statements and names in publication via e-mail. Two interviews were conducted on Skype. All interviews were audio taped and transcribed verbatim. Translations from Russian are provided by the author of this paper. Following the transcription, all interviews as well as written answers were coded, and 12 most common categories were extracted to apply them in the analysis of the 1980s and 1990s periodicals, especially *Teachers Gazette*, archival materials, and other publications including research literature or pieces produced by innovators themselves.

4.3 Setting the Scene: The War Game of Innovations

The history of educational innovations from 1945 onward is abundant with controversies since the possibility of delivering some real change in practice was coupled with political climate of the Cold War. Before the late 1940s, the process of renewal in education was not treated as a rapid breakthrough reinforced by national governments. Paul R. Mort and his colleagues at Columbia University in the 1930s

and 1940s developed a sustained evolutionary account of innovations. According to Mort, innovation is a rather slow, literally decades-long process of adopting the changes in the educational system. Such process is in turn generously supported by constant increase in public expenditures per each pupil (Mort and Cornell 1938). It was a gradual *adaptation* of the older institutions or practices to emergent needs and capacities that Mort's group presented as the driver of educational transformation (Farnsworth 1940). The term "innovation" remained mostly synonymous to the adaptation although slightly favoring a specific connotation of novelty with respect to both needs and practices of educators. It is worth noting that evolutionary discourse of innovations was by definition not aimed at the immediate redesign of the process of teaching itself but rather on the extension of library services at schools, regular medical inspection of students, or special treatment for mentally retarded children (Farnsworth 1940). This evolutionist account of educational innovations was overshadowed by the Cold War. The launching of Sputnik, in particular, produced a profound shock to the American political establishment and to the American society as a whole. Although "Sputnik moment" should by no means be singled out as the only cause for changes in innovations research and politics, the shift toward an organizational perspective in American context in the 1960s was evident. Innovations were now put under the umbrella of preplanned and organized institutional efforts to transform curriculum and instruction methods (Committee for Economic Development [CED] 1968). While recognizing the importance of individualized learning, multilevel bureaucracies and business groups in the USA emphasized the role of instrumental technology and proper management in education. Dissemination of innovations got a much closer linkage with recurrent accountability for external audit as well as with technocratic ambitions of behavioral engineering (Aerospace Education Foundation [AEF] 1968). Inspired by the vision of establishing an "industrial pipeline of innovations" (Clark and Guba 1967), corporate lobby rushed to play leading part in educational policy advocating for transparency of schools in terms of their efficiency and effectiveness (CED 1968). In the early 1970s, humanistic approaches advocating for self-directed learning within a diverse, friendly environment were reinforced once again (Committee for Innovative Education of the Delaware County [CIEDC] 1971). Yet the organizational stance prevailed and even culminated in the *Nation at Risk* report in 1983 (National Commission on Excellence in Education [NCEE] 1983). Innovations also attained much closer linkage to the promotion of individual and collective entrepreneurship.

At that very moment, another nation which presumed success in educational policy once animated America's strive for innovation in education, the USSR, was headed for the last educational reform in its history (O reforme 1984). The rhetoric of party officials propagating reform was all about the improvement of teacher's standing in society, greater respect, and financial provisions for teaching profession. In contrast with America, little if anything was said on the accountability of schools and teaching staff. The lack of proper data made almost impossible for educational institutions to benchmark across the country let alone to carry out cross-national comparisons (World Bank 1995). Despite the launch of new educational reforms in

1984, Soviet officials believed that the educational system, as a whole, was on the right track and sketched long-term plans for improvement of the existing system by 2000 (O reforme 1984). Although the political climate in general grew milder after Michael Gorbachev came to power in 1985, Soviet schools and educators in general remained loyal to the ruling party and its communist ideology. The decisive breakthrough arrived in late October in 1986 with the publication of the *Manifesto of the Cooperative Pedagogy* in professional newspaper *Teachers Gazette* (Lysenkova et al. 1986). It was this newspaper and its editor in chief, Vladimir Matveev, who started to organize teachers' activities across the USSR, which were based on the Manifesto. Matveev's *Teachers Gazette* (*Uchitel'skaia gazeta*) succeeded in establishing a substitute for a public sphere to discuss pressing issues facing the teaching profession. Yet, as party ideological control was still in effect, discussion of school management and strategic goals was hardly possible. *Teachers Gazette* was instrumental in promoting national exposure for so-called novators (*Novatory*), a group of teachers who were especially successful in (re)inventing and applying allegedly innovative tools for class instruction. The *Teachers Gazette* and its editorial staff were harshly criticized by representatives of Soviet Academy of Pedagogical Sciences (APS) for their "amateur" and "un-comprehensive" approach to the delicate issues of pedagogical experimentation (Likhachev 1987). As educational "novations" were basically promoted by means of pedagogical journalism, the movement was at first detached from scholarly expertise. TV and radio supported popularity of *Novatory* broadcasting their lessons to a broader audience. The *Novatory* themselves, as well as journalists of *Teachers Gazette*, suddenly turned into all-Soviet media stars. Although creating a certain flavor of recognition around the Innovative Movement, *Teachers Gazette* was not in position to act as a powerful sponsor of educational change in terms of official policy. For example, at the end of 1988, its editor in chief Matveev was forced to resign. At that time the pendulum implicitly swung away from practical problems of teaching to an ambitious task of shaping new national educational policy. In 1988 all educational entities in the Soviet government were merged into one State Committee of Education—a, huge super ministry with unprecedented human and material resources. The head of SCE, Gennadii Yagodin, invited ambitious historian of education, Eduard Dneprov, affiliated with APS, to chair a group of experts commissioned with the task of developing a new conception of secondary education. Dneprov was keen on not missing this opportunity.

4.4 (In)novators: Old and New

In 1990, Russia proclaimed its national sovereignty, which meant a rapid breakup of the USSR. Dneprov was elected as the first Minister of Education of barely existent new nation and presented precisely those conceptions that were elaborated 2 years before as his program, less than a year and a half after the Soviet Union collapsed. Paradoxically enough, it was around 1991 that the previously celebrated *Novatory* disappeared from public eye. What was at stake now was the overall

conception of a new school for the new democratic Russia. Since Soviet schooling stood for control and coercion, Dneprov and his coworkers opted for decentralization of educational policy, a reasonable choice, given the rapidly deteriorating state capacity and dramatic decrease of funding (World Bank 1995; Webber 2000). The overall flavor of educational policy was predominantly negative, owing to a mere opposition to everything "Soviet" from school uniform to textbooks to fixed curricula. This "big bang" strategy (Johnson 1997) produced a chaos of particles, for example, schools rotating around their own orbits. It was at that time when innovations and innovators were those ones who benefited from it most of all. There is still no sufficient evidence with regard to who was the first to label certain grassroots activities as innovations. From 1989 onward the term was given some credit (Prigozhin 1989; Yusufbekova 1991; Klarin 1994), although this strain of literature remained relatively small in comparison with publications concerning *Novatory*. The scholars who wrote on innovations at that time displayed a considerable degree of familiarity with Western literature on the subject, though with no special focus on organizational theory or transferring innovations into broader practice. It seems rather likely that innovators just borrowed the term which had been in the air for some time. While providing some linkage with already existing hype around *Novatory*, the term explicitly distanced this new wave of pedagogical movement from preceding events.

Well before Perestroika there were lots of teachers advocating for the fostering of children's creativity as a core instructional principle. Most of them were eager to share their techniques although only in a mature form, as a finished product. The efforts of separate activists were embraced as a pedagogy of cooperation (*sotrudnichestvo*), a term coined apparently by well-known pedagogical journalist, Simon Soloveichik, in 1986, which referred to a specific manner of teachers' relationship with children based on cooperation and respect. That approach stood very much in line with the overall strategic priorities of official reform, which claimed personality development to be of the highest importance (O reforme 1984). Although some prominent teachers-novators repeatedly referred to official documents as true guidelines for their practice (Bazhenova 1987), innovators moved much further in their outright criticism of Soviet schooling as such (Johnson 1997; Webber 2000). That was in fact a logical option for them since they often were not professional teachers, or at least they strived to become something more than just teachers-organizers, managers, and activists. As outsiders, with respect to both schools and scholarly establishment at the Academy of Pedagogical Sciences, they devised new ways to spread their ideas. *Teachers Gazette* staff member, young former science teacher Alexander Adamsky launched a network of professional exchange built around pedagogical events (*festivals*) to be held in different regions of the country. The very name of this network, Eureka, referred to the joyous feeling of finding new ways to do things professionally. The movement culminated with the attempt to create an All-Soviet Union of Creative Teachers in 1990. With the collapse of the USSR, innovators rushed into the new era willing to destroy each and every remnant of the Soviet school (Webber 2000). Yet, since its inception in 1991, no new ideas or figures came out of this Innovation Movement. Without

access to electronic means of communication, particular innovators had to act completely on their own, facing the need either to establish some tactical coalitions with their local surroundings or to appeal directly to some independent sponsors mainly from abroad. In fact, it was the Soros foundation that, in 1993–1995, supported 100 "innovative" schools across the country, chosen through a murky process of expert surveys (Latsis 1995). Around 1994 the Association of Innovative Schools and Centers was founded (Dneprov et al. 1997).

As early as in 1995, Association's first president, a headmaster of a renowned Moscow school № 731, Alexander Tubel'sky, was convinced that the Innovation Movement had already been "dying" (Kerr 1995). By 1998 the Association seemingly ceased any activities after publishing a comprehensive volume representing innovators in their own words a year before (Dneprov et al. 1997). By 2000 it became obvious that the greatest part of schools in the new Russia remained unchanged, with management and staff hostile to the very word "innovation" and the prospects for further development rather unclear (Webber 2000). Russian educational policies after 2000 already received some coverage in the research literature (Dneprov 2006; Gounko and Smale 2007; Silova 2010; Luk'yanova 2012), but those accounts are focused primarily on the growing neoliberal profile of educational policy, with its focus on accountability and quality assessment. With the World Bank's adoption of the first educational loan to Russia in 1997, international organizations benefited from much greater influence on the national agenda in educational policy (Minina 2014). Before 1997, the World Bank or other international organizations were not involved in projects directly addressing issues of educational reform in Russia (Stephen Heyneman, written answers to author's questionnaire, e-mail message, May 26, 2015), although a sizeable amount of ground reports and analytic papers were produced dating back to1993 or even earlier (Stephen Heyneman, written answers to author's questionnaire, e-mail message, May 26, 2015). The 10 years between 1986 and 1996 were seemingly the only moment when teachers and school management launched a full-blown remake of profession on their own, given the sudden absence of government control and relative detachment from the scene of rising global neoliberal educational policy. Although the factual story of those turbulent years was highlighted in a number of publications (Jones 1994; Sutherland 1999; Webber 2000), the reasons for rapid decline of the Innovative Movement are still to be unraveled in full clarity. With few international stakeholders on the scene at the time and rapidly deteriorating state capacity, it were educators themselves, their ideas and actions that either drove the change or made it a dead end.

4.5 The March of (Socialist) Innovations

In March 1987 a renowned Soviet pedagogical journalist who published extensively on education issues Simon Soloveichik came out with a cycle or articles under the general title "Ivanov's life" in the *Teachers Gazette*. Ivanov, according to Soloveichik, was among those rare scholars who truly brought Soviet pedagogical

theory into practice (Soloveichik 1987a). From the early 1960s onward, this Leningrad-based researcher developed a conception of *common creative deeds*, which was guided by the assumption that children and teenagers collectively stand out as real game changers in social reality (Dimke 2015). While explicating Ivanov's ideas, Soloveichik claimed that a child's nature is intrinsically dual so that it combines individual as such and a "tiny part of collective, nation, society" (Soloveichik 1987b, p. 4). According to Soloveichik, this duality unfolds itself in the process of upbringing, which is a combination of individual development and socialization (Soloveichik 1987b, March 28, p. 4). Henceforth, in this strain of articles, Soloveichik develops his central thesis, presenting pedagogy of cooperation as the only possible way to combine humanist and collectivist pedagogies thus establishing "truly communist relationships in the process of upbringing" (Soloveichik 1987c, April 2, p. 5). Cooperation pedagogy was introduced rather smoothly as nothing but a natural outgrowth of the whole history of Soviet school. Soloveichik's representation of *Novatory* emphasized their proximity to Ivanov's "Marxist-Leninist" beliefs since they both share the aspiration for unrestricted creativity of the youth. Quite in line with official rhetoric (O reforme 1984), cooperation pedagogy was described as a grassroots creative process "pushed forward by the will of numerous persons and collectives" (Soloveichik 1987c, April 2, p. 5). Wide circulation of mass creativity ideal in the Soviet context made it much easier to legitimize *Novatory* in the public eye blurring the boundary of political clichés and pedagogical techniques (Sigman 2014). An overall progressivist stance of Soviet ideology covered a broad array of meanings. Yet, at the same time, it undermined the possibility to define precisely what exactly was done by teachers in a newly developed manner. To an extent *Novatory* in terms of their professional performance were just as new as every Soviet teacher ever. Not surprisingly, for ordinary teachers who shied away from (In)novative Movement initiatives, the *Novatory* made no difference. Instead, despite upheavals of Perestroika, such teachers felt the "sameness" of their everyday labor, because "in our business it is teachers' creativity only that always matters" (Tatyana Emelina, interview with the author, May 19, 2015). For some teachers, discussions of *Novatory* even did not distinguish from campaigns for better in-service teacher training ignited regularly by national or local authorities (Galina Semyonova, interview with the author, April 20, 2015). In retrospect, they are sometimes prone to label all activities connected with Innovative Movement as a sheer "bureaucratic lip service" (Grigorii Mednikov, interview with Artyom Kulakov, January 6, 2016).

The role of *Teachers Gazette* in promoting innovation should by no means be underestimated. The flow of publications on *Novatory* not only expressed its importance but somehow ensured its institutionalization through multiplied monotonous repetition (Yurchak 2006). The importance of teachers' creativity was reinflated with the start of "public" discussion of the 1984 education reform. The *Teachers Gazette* campaign around experiments of *Novatory* was at first seen as a part of reform propaganda. Step by step, the staff of *Teachers Gazette* took relative control over the discussion of Innovation Movement due to the help of liberals in the party establishment (Alexander Adamsky, interview with the author, March

21, 2015). The diffusion of innovations was promulgated through constant repetition of a limited set of names and ideas from national newspapers and TV channels, pouring onto audiences that were not accustomed to the critical assessment of information. It is against this background that the stress on "teacher as journalist" (Tsirul'nikov 1987, p. 3) should be understood. Since those teachers-journalists were insiders in the apparatuses of propaganda, their ideas were easily scaled up to visibility for the whole professional community. This "omnipresence" of creativity supported the ground for temporary tactical coalitions of bureaucrats and teachers (Sigman 2014). Education went ahead of everything else:

> [t]here was a moment when we decided that education could realize itself independently of economic and social conditions. There was a moment when we decided that education could go first no matter which fiscal system you have, no matter public spending, no matter how people are living, no matter property rights. <...> No matter how public administration is arranged, whether you have elections, democracy. No matter. (Alexander Adamsky, interview with the author, March 21, 2015)

The wording used to promote those initiatives in education, including such terms as "experiment" or "experimental school," contributed to the popularity of the movement and yet highlighted detachment of its members from professional community. Since those experiments were rather explicitly mentored by academic elites and/or party and state officials (Vyatcheslav Losing, interview with the author, February 9, 2015), they were excluded from the common educational space. Teachers who worked for those experimental schools "felt like a little bit outside away from the general system" [choreography teacher, Kemerovo]. Immersed in the games of elites, the Innovative Movement was prone to manipulations which "recycled" its initial ideas in favor of local politicking. Thus, for example, the chancellor of the Siberian Krasnoyarsk University supported an experimental school affiliated with the university because of the would-be reputational benefits from such an undertaking (Boris Khasan, interview with Ksenia Sidorova, January 6, 2015). Institutional development as well as establishment of professional associations lagged way behind:

> [I] did not see this level [*as compared to the US—P.S.*] of variety and activity in the USSR. I know that there were organizations and groups, and conferences and meetings of various kinds, but there did not appear to be as many variations and (of course) none of the political activity (at least none that was visible to those looking in from outside). At the time, it seemed to me, that if one thought of the educational system as a community of living, biological organisms, this situation of lack of variety would be an indicator of problems or risks to come. (Steve Kerr, written answers to author's questionnaire, e-mail message, April 7, 2015)

The solitary position of certain educators and schools undermined the diffusion of experiments and decreased adaptability of such institutions in changing societal conditions. In fact, many innovators opted for an outright distancing from any civic activity:

> [I] realized that I could only survive keeping low profile. I was not asking anybody for anything. I was not looking for any shortcuts. I was just doing my job very quietly. So no one suggested any assistance to me and yet I was pretty good with that since nobody was trying to stop me. This was so unusual and so great! (Boris Bim-Bad, interview with the author, March 17, 2015)

Apart from ideologically driven dissemination of creativity discourse, there turned out to be no other means to distinguish and detect educational innovations. It appeared suddenly that even innovators, themselves, did not treat the movement as a collective entity united by any common principles and ideas or, for that matter, expertise (Victor Bolotov, interview with the author, February 5, 2015).

4.6 Charismatic Structuring

Many educators around the world use the term "innovation" to refer to their instructional techniques or methods. Yet it was only in the Soviet context that innovations were associated with the personality of a certain educator. Many innovative experiments were adjusted to personal likes and dislikes, interests, and capacities of one charismatic person. Such person quite often had an ambition of no less than creating an "entirely new" system of instruction (Steve Kerr, written answers to author's questionnaire, e-mail message, April 7, 2015). So closely was teacher creativity connected with the actual presence of certain personality that it seemingly embodied the very sense of novelty:

> [I] was preparing a science project with a class. And we were supposed to present it at school festival first and then to other schools and then on the city level. Yet that all was *only when I worked with Losing*. And all other schools... Well *I only understood what novation is when I happened to work with Losing*. And everything else was... you know...so traditional. (Svetlana Akimova, interview with Artyom Kulakov, November 20, 2015, italics added—P.S.)

Charisma, unfortunately, could not be transmitted or transferred, regardless of personal contact. This unique event was memorized rather strongly, yet it could not be communicated to anyone who had never witnessed the same charismatic person. Diffusion of innovations was bound to personal networks with no massive press coverage already and yet with no e-mail. Many innovative schools have chosen a posture of outright detachment from supposedly hostile or underdeveloped local environments (Tatyana Kovalyova, interview with the author, January 20, 2015). "Going to be something new" (Harley Balzer, interview with the author, April 8, 2015), they missed the point of innovation's transmission to secondary education. In contrast with declarations (or aspirations) of some prominent innovators (Kasprzhak 1992), secondary education was not destroyed; it just was out of their sight. The fragmentation of the system of schooling increased dramatically after 1991. Originating entirely from state-funded planned-out educational system, most innovators were unaware of specific issues of financial management. In fact they just could not imagine what schools' financial autonomy might look like and preferred to demand extra

funding from the state, which only deepened the rupture of mass and elite "innovative" secondary education [Interview with Natalia Tipenko]. Even economists at the end of the 1980s took for granted the existence of a redistributive socialist economy supported by centralized planning and local industrial facilities (Saburov et al. 1988). Dissemination of newly emerged "experiments" was downsized to personal communications with colleagues and government officials. Personal relationships were used as leverage to demand preferences, for example, through weaker control and greater financial support (Natalia Tipenko, interview with the author, January 26, 2015). Without valid, national educational statistics (World Bank 1995), it was almost impossible to make any solid conclusions about relative success of different "experimental" schools. The striving for novelty, prone to equating innovation and reform (Harley Balzer, interview with the author, April 8, 2015), subverted systemic change in favor of supporting the "best," yet their presumed paramount quality was quite often evidenced by nothing else than mere expert opinions obtained from professionals from nominated schools (Latsis 1995). In a way, the whole issue of institutional development, in the case of innovators, turned out to be the development of their bargaining power. Informal communication prevailed, with a negative impact on the overall institutional culture since the value of networking dominated national policy issues slanted according to personal ties. Although heavily dependent on networks of patronage and loyalty, innovators still envisioned themselves as "authors," namely, as creators of brand new philosophical or scholarly accounts (Tatyana Kovalyova, interview with the author, January 20, 2015). The term "authored school" was coined to refer to schools created by innovators from anew as works of art or scientific inventions. This term was widely used in the 1990s and afterward to pinpoint innovative institutions (Dneprov et al. 1997). Mostly detached from their environments, these "author schools" usually turned to be enclaves of charismatic leadership.

The idea of sustained subjective identity is built upon a strong sense of belonging to some meaningful community. A Soviet socialist order provided a universal example of that kind of unity in the USSR. Therefore, those Soviet citizens who strived to position themselves out of that seemingly universal frame had to invent their "private" collectivity as an alternative to the Soviet project. This primarily negative anti-Soviet identification rotated around socializing in a circle of close friends, which was extremely important for innovators just as much as for any other citizen of the late USSR (Yurchak 2006). A free individual was not supposed to act as a citizen since the public sphere was so heavily dominated by Soviet ideology. Instead they were supposed to be reliable persons, trustworthy comrades—i.e., friends. So solid seemed the framework of socialist order that the very possibility of its absolute destruction was merely unthinkable. At the same time, it was Soviet ideology or more precisely its institutional framework that maintained social bonds. Apart from those bonds, no forms of independent civic self-organization were in place to step into the public arena after rapid dissolution of the Soviet regime. It was party-controlled press and TV, party, and state officials who effectively backed the rise of pedagogical movement. In absence of this neglected infrastructure innovative movement turned to be what it was initially—a circle of friends.

4.7 Conclusion: Solitary Innovations

The collapse of the Soviet Union was a shock not only economically but institutionally. From 1985 onward till 1991, the central government played a decisive role in education reform. After 1991, education was not a priority anymore; most schools had to survive on their own, though it was not a linear transformation by any standards. Since innovation is now a buzzword for educators all over the world, this field is rather controversial. Much of this controversy was entailed by the uncritical use of some core assumptions. By far the most influential theory, Roger's (2003) conception of the innovation diffusion, is heavily framed with the linear understanding of the whole diffusion process. Other popular approaches to innovations studies share a similar linear frame (Christensen 1997; Fenn and Raskino 2008). Diffusion of innovations is represented as a gradual succession of stages, one following one another. Once an innovative idea becomes a product (a material object or technology) in the course of this process, it gets alienated from creator. It is presumed that innovation has to be able to exist independently of inventor's control. Things developed in completely opposite direction in case of Soviet innovative movement. The more visibility it acquired in the public eye or in the eye of international sponsors or experts, the more heavily it was relying on a few charismatic leaders. State failure reinforced the process of *subjectification*: making change downsized from national level to the level of particular persons reinventing themselves from the scratch. Yet the very sense of *Sovietness* remained as unquestioned as it was before 1991. Soviet superpower was dismantled too rapidly to spare any time to reflect. The feeling of perplexity had driven the pendulum to the complete rejection of the Soviet tradition of schooling (Webber 2000). Soviet schooling, as such, was alleged to be "out of commission" (Kasprzhak 1992), yet the pedagogical staff, the system of in-service teachers' training, and the physical environments of schools remained the same. As early as in 1995, international experts warned that no educational system could exist without translating some "common sense of citizenship" (World Bank 1995, p. 38). That common sense was so far obfuscated by impertinent struggle for personal emancipation from the bygone Soviet leviathan. Therefore, educational reform as a concerted set of institutional efforts apparently stopped soon after the dissolution of the USSR (Polyzoi and Dneprov 2010).

In contrast to Fullan's (2001) conception, initiation and implementation of innovations do happen together sometimes. To initiate the transformation of one's own consciousness is to implement new ways of thinking. Perhaps, that is the only way for innovations when a familiar social order falls apart. People need time to realize how deep the unpredicted and abrupt change would be. They need time for *osoznaniye (*Harley Balzer, interview with the author, April 8, 2015), i.e., to confront the challenge and to think it over. Innovation could manifest itself as a change of mindset if not of institutions. Moreover, subjectification of innovations as a meaningful part of an individual's experience might be necessary for the proper support of institutional innovation campaigns later on. Outer institutional dimensions of innovative processes and the inner experience of emancipation and

creativity are not two poles apart; the history of Russian innovative movement provides a clear evidence of what might happen when only "subjective" part of innovations is at stake while the complexities of making new structures of decision-making are neglected. Though the context was favorable to grassroots initiatives before 1997–1999, no system of institutional incentives was established; neither were there channels of diffusion set in motion. Instead, choices made primarily protected the authenticity of one's brand of "authored school" at the expense of diffusion. That excessive personal branding was detrimental for subsequent perception of innovations in professional teacher communities in Russia. Solitary innovations of *authored schools* in turn took defensive attitude to their presumably hostile environments. There is of course no such thing as one-size-fits-all model of innovative development. In studying the case of the Russian innovative movement of the 1980s and especially 1990s, we do not see a coherent set of policies designed and/or enforced by government. Does a personal change, no matter how profound, deserve the name of innovation at all? It is tempting to dismiss this whole story as irrelevant to the proper study of educational innovations. Some change in Russian education had obviously happened after 1991. Yet it was primarily a transformation in the self-understanding of certain educators. The unexpected triumph of subjectivity decoupled innovations as personal emancipation from civic actions seeking to re-create the founding principles of educational system as a whole. Ironically enough, institutional infrastructure for innovations was maintained by totalitarian state only. The massive decline of state's capacity to pick and choose and promote certain innovations had a detrimental effect on the prospects of Russian innovative movement in absence of any other independent stakeholders to set the track of reform. Yet the government's comeback on the scene of educational policy after 2000 has not produced an influx of grassroots innovations, as compared with the late 1980s. Apparently both the government and professional and civic networks together are needed to sustain an innovation. How shall we inhabit institutions with grassroots initiatives? How shall we reconnect the state and the people in a way that would effectively deliver educational innovations? These questions are now pressing for educational policy professionals in Russia, just as they are so for their colleagues across the world.

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Innovators from Within and from Without the Education System

5

Diana Koroleva and Tatiana Khavenson

5.1 Introduction

The term "innovator" has many synonyms such as inventor, creator, visionary, pioneer and others. This terminology has been applied in the business sphere for a longer period than in education. One of the earliest descriptions of innovations and innovators was offered by Schumpeter (1949). According to Shumpeter, innovation is a special process initiated by an innovator, an individual entrepreneur who supplies the market with unique commercial ideas based on a new approach to using already known resources, search for new sales markets, destruction of obsolete mechanisms (reorganization) and so forth.

Rogers (1962) developed a more complex model in which the innovator plays a special role. According to Rogers, being an innovator means (1) being able to control financial resources in order to minimize possible losses that result from loss-making innovations, (2) understanding and applying complex technical knowledge, (3) being able to cope with a high degree of uncertainty about innovations and (4) being willing to accept the occasional setback when an innovative idea does not find resonance with the community or is not as effective as expected. Both these fundamental theories allow that an innovator may, but not need, be an "inventor" of the product or the process he or she introduces.

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The important difference between the adaptors who desire to do things *better* and innovators who seek to do things *differently* is fundamental to Kirton's (1976) adaption–innovation theory. According to Kirton, the innovator has the following characteristics: being undisciplined, approaching tasks from unsuspected angles, treating accepted means with little regard in pursuit of goals, being capable of detailed tasks only in short bursts, providing the dynamics to bring about periodic revolutionary change and having low self-doubt when generating ideas (cited by Stum 2009). He contrasts the inventions produced by the independent innovator and the independent entrepreneur with large business enterprises' inventions. Speaking about differences between inventive entrepreneurs and incremental innovators, Baumol (2004) highlights three key features: first, contributions to economic growth; second, the educational levels; and, third, the nature of the educational process itself. After reviewing the biographies of the most celebrated innovators such as Watt, Whitney, Fulton, Morse, Edison and Wright brothers, Baumol demonstrated that in a surprising share of these cases, the most remarkable part is the absence of rigorous technical training and, in many other cases, little education at all.

The question that arises here is whether these characteristics can be applied to innovators in education. The educational system is different from the business world in the sense of accessing external people. It is hard to imagine teachers or instructors without formal education or school or other educational institution acting without licence. While it is possible in extracurricular education, there is no systematic basis for these activities. Formal education keeps such initiatives at a distance, which has led to a situation in which we know more about actors "inside" education, those who accept and implement innovation within the educational system, than about those who act from "outside" the system. According to Fullan (1993), Marsh and Huberman (1984) and Rudduck (1991), the key role during the innovation implementation stage belongs to the system entities and the system leaders, i.e. the innovators, who are ready to accept innovation by adapting and improving to meet their vision. Teachers who act as agents of innovation play an essential role in implementing innovative pedagogical practices (Krajciket al. 2008; Urhahne et al. 2010). According to Webb and Cox (2004), teachers' personal knowledge, beliefs and values influence the process of diffusion. This means that, as key agents in the diffusion process, teachers can stand against the innovation unless they buy into them despite external pressure. However, there are innovators around the education system who are trying to penetrate the system: innovators from without. Those include grassroots innovations and actors operating in this field. Based on the concept of innovation and challenges of innovative projects in the field of education that the Organisation for Economic Co-operation and Development (OECD) has developed, Koroleva and Khavenson (2015) have formulated the following concept of "innovator in education":

> These are actors, who generate and promote their own ideas or adopt innovations. The actors are open to new experiences and are ready to take risks. They take the initiative and apply imagination and creativity. The innovator's activity in education is aimed at improving the results and effectiveness of education, equalizing access to quality education, and improving the administration of the education system in accordance with the actual needs of modern society. (p. 343)

In order to increase the volume and quality of innovation in education and improve the system, we need to know who these people are and what motivates them to conduct innovative activities, which environment they need to be more innovative and what kind of support they require. This chapter describes the contemporary innovator in education "from within and from without" using their socio-demographic status, values and motivation.

5.2 The Study

In 2014 and 2015, two rounds of Russian national competition for Innovations in Education were conducted in order to explore existing grassroots innovative projects. The analysis of participants suggests the existence of a large group of innovators outside the educational system ready to offer ideas for improving the education system. In addition to the competition's application form, participants were asked to take part in an additional voluntary survey. In the first year, 577 teams of innovators submitted the applications for the competition, and 304 of them responded to the questionnaire. The second round of competition yielded 678 applications from individuals and teams. We collected 437 responses to the survey. This study sought to identify the main characteristics of contemporary innovators in education, their distinctive social and professional features as well as their value orientations and motivation.

In the first wave of the survey, we focused on *value orientations* of innovators in education. We measured values using Schwartz's approach (Schwartz and Bilsky 1987). Value profiles of innovators obtained from the study were compared with those of Russian population as a whole, as constituted in the results of the European Social Survey 2012 (ESS). According to Schwartz and Bilsky (1987), a value is an individual's perception of a desired goal. This value determines the motives and mindset of the person when dealing with a number of situations in life, and it determines the person's attitude to many aspects of life (Schwartz and Bilsky 1987). The theory of values identifies ten core values:

1. Self-direction—independence of thoughts and actions. Main characteristics: creativity, freedom, choosing own goals and propensity for innovation.
2. Stimulation—a feeling of enthusiasm and eagerness, novelty and challenge in life.
3. Hedonism—looking for pleasurable experiences, sensuality and enjoying life.

4. Achievement—desire for personal success and demonstration of one's own competence in social norms, obtaining social approval.
5. Power—the desire to achieve social status, prestige, control and dominance over people or resources. Both the values of power and achievement are focused on how the individual is assessed by society, though achievement is the desire to demonstrate status that has been earned by one's own successful activities, and power is the desire to consolidate one's dominant position in the social hierarchy.
6. Security—preference for security, harmony and stability in social and personal life.
7. Conformity—self-restraint in one's actions and voicing one's own opinion, avoidance of violations of social norms.
8. Tradition—respect for traditions and agreements as well as adoption of ideas and rules from existing culture or religion. Conformity and tradition are values that are close in terms of behavioural motives. However, they differ in terms of their scale: the value of tradition motivates people to behave consistently with the dominant religion or social order, whereas conformity is the willingness to adapt to people frequently encountered in daily life.
9. Benevolence—the maintenance of the well-being of a person's loved ones. People who wish to show benevolence and conformity are motivated to engage in cooperative and supportive behaviour, but benevolence in particular helps a person internalize these motives, while conformity promotes such behaviour largely due to a desire to avoid negative consequences.
10. Universalism—understanding, appreciation, tolerance and protection of all people and nature. Universalism is close to benevolence, but it focuses on larger society and world, but benevolence has in-group focus (Schwartz 2012; Schwartz and Bilsky 1987).

Societies' values tend to be linked with their development and characteristics (Inglehart and Baker 2000; Schwartz and Sagie 2000; Schwartz and Bardi 2001). Values are also related to many characteristics important to innovators (Kasof et al. 2007; Gorgievski et al. 2011). Considering creativity as a feature inherent to innovators, we also rely on Kasof et al.'s creative behaviour, which is promoted primarily by the self-direction value type and to a lesser extent by the stimulation and universalism and is inhibited primarily by the tradition, conformity and security value types.

Analysis of small business owners' success criteria and its correlation with the values of an individual show that entrepreneurs, who define innovativeness as success criteria, have self-enhancing value orientations (power and achievement). Softer success criteria such as having satisfied stakeholders and good work–life balances were guided by self-transcendent value orientations (Benevolence and Universalism). As for relation of personal characteristics (values of the individual) and motivation for strivings and endeavours, please see Schwartz and Bilsky (1987), Sheldon and Elliot (1998, 1999), Sheldon and Houser–Marko (2001) and Koestner et al. (2002).

Based on the idea that values convert into specific reasons for creating the project, the next step of this research was formulated: study innovators' motivation, focusing on a particular situation (producing innovation), rather than on values disposition in general. In 2015, this study of innovators' motivation was conducted with 437 responses. Our motivation scale was the adopted Russian version of one used in Panel Study of Entrepreneurial Dynamics (PSED) and others (Germak and Robinson 2014; "Panel Study of Entrepreneurial Dynamics" 2016).

5.3 Education, Occupation and Project Sphere

As indicated in Fig. 5.1, the survey respondents included 63% females and 47% males (which also reflects gender bias in the Russian educational system). All participants displayed a high level of education: 58% of respondents had completed tertiary education and one third of them held PhD degrees. More than a third of them were working in schools; 20%[1] were teachers and 10% represented school management. 52% indicated working in higher education institutions, 39% of them taught and conducted research and 13% of respondents worked in managerial positions. 14% were extracurricular education teachers. Few percentages of participants reported having been educated in vocational education institutions (8% of them identified as instructors and managers). The percentage of respondents having their own business was 15%, and people who reported working in organizations not related to education (15%) also participated in the study. 18% of respondents worked only in this innovation project.[2] At the same time, half of participants (53%) reported some experience participating in competitions and contests in the field of innovation in education.

According to our analysis (Fig. 5.2), the most popular spheres where innovative projects are created and implemented are secondary schools, innovations in extra-curricular activities as well as in vocational and higher education. Bearing in mind that very few people in our sample are from vocational education institutions, we conclude that people from other spheres are ready to participate in innovative projects and actually willing to create an innovative environment. In comparison with other spheres, relatively small number of projects appears to be implemented within family as well as preschool education.

[1]The total in occupation question exceeds 100% because respondents had options to choose more than one answer. Working on full-time and part-time positions in different places is quite usual in Russian educational sphere.

[2]We described here the characteristics of 2015 sample. In 2014 the results were similar; hence we do not provide it here to save space.

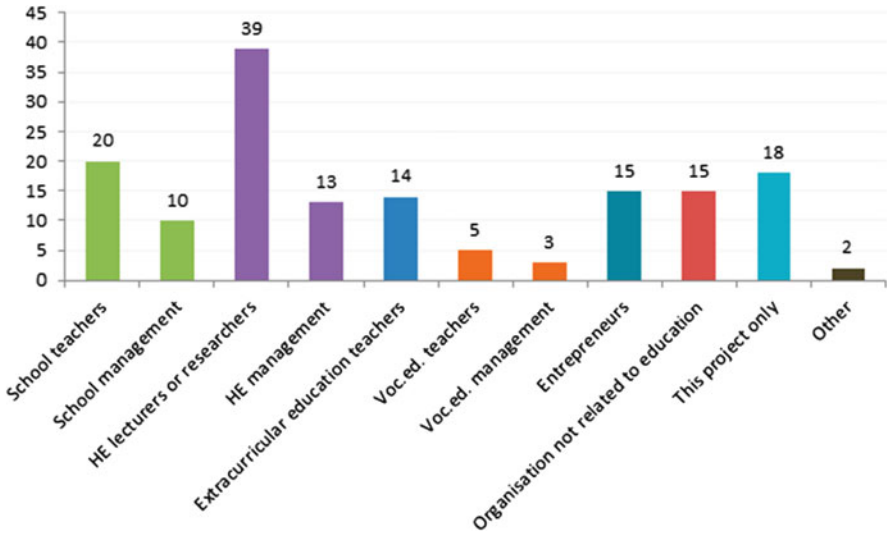

Fig. 5.1 Competition participants' occupations

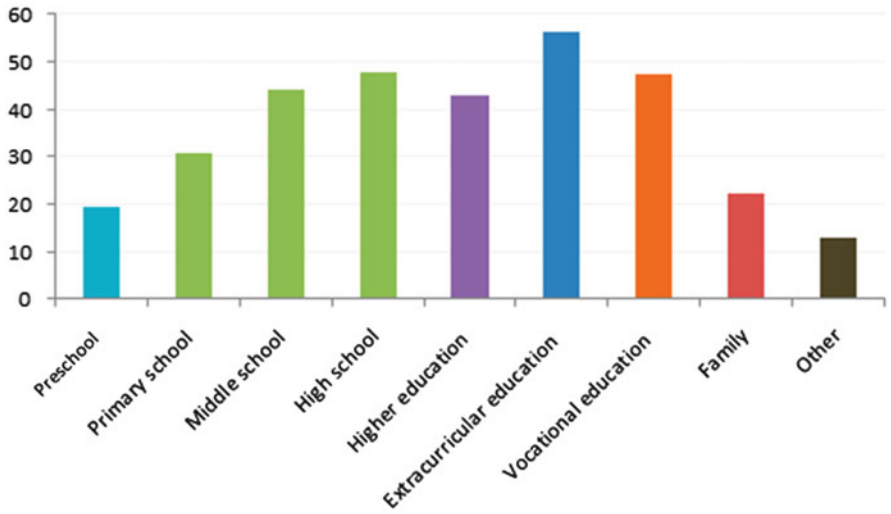

Fig. 5.2 Projects' sphere distribution

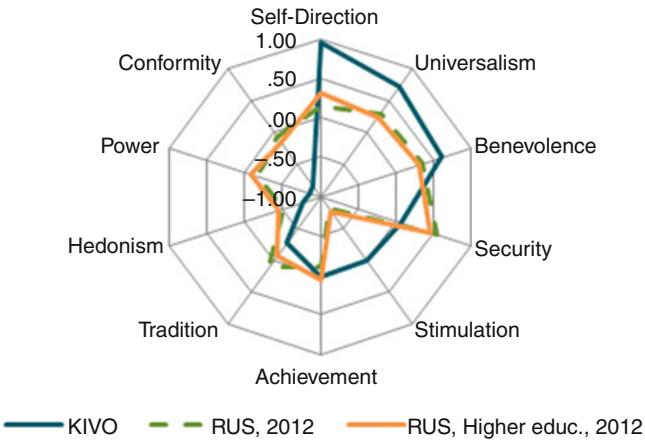

Fig. 5.3 Comparison of value orientations of competition participants and (KIVO) and Russian population (ESS)

5.4 Values

The value profile of participants in Competition for Innovation in Education is significantly different from Russia's population as a whole (Fig. 5.3)[3]. Values of self-direction, universalism and benevolence are the most prominent distinguishing traits. Across the Russian Federation's wide sample, the indicators for these values are also positive, although not as high. The high rate of self-direction, according to Schwartz, is attributed to the tendency of innovators to be independent in their actions and thoughts; they are not afraid of new approaches and are characterized by ingenuity and curiosity. The competition participants seek to control what happens, and they rely on their own skills and abilities. At the same time, the combination of self-direction and universalism provides even more independence in judgements, understanding and patience.

Universalism and benevolence are combined into a larger category of "attitudes that consider the needs of others" (Schwartz 2012, p. 8), meaning that innovators wish to direct their activities to improving the lives of others. A specific aspect of universalism includes positive attitudes aimed at a broad social group. It is a desire for peace and the promotion of general welfare. However, benevolence largely relates to a person's immediate environment: family members, colleagues and those with whom a person interacts regularly.

[3]Since contest participants have high level of education we compared them not only with the Russian population as a whole, but also with the group of Russian citizen with higher education. Figure 5.3 shows that the results are identical.

Such values as security (rank 4), achievement (rank 6) and stimulation (rank 5) were not ranked highly by innovators (Fig. 5.3). However, the ranking of these values is much higher for the Russian population as a whole, for whom stimulation is ranked at the bottom (rank 10), achievement has an average score (rank 7) and security has the most priority (rank 1). These three value orientations and those described above are alleged to determine innovators' behaviour. The ranking of security value reflects the high demand across Russia for security and stability. For potential reformers and entrepreneurs in the field of education, security is also important, as it is for the rest of the country. With regard to achievement and stimulation, innovators are ready to work hard, they always try to find new tasks to perform and they believe that it is important to try a lot of different things in life. They are ready to take risks. It is important for these people to demonstrate their abilities and to be successful. They are interested in ensuring that their activity is respected for its merits by others. The innovators rely on the protection of others or to a lesser extent, the state, than Russians, in general; they perceive themselves to be prepared to meet difficulties and overcome them on their own.

Tradition (rank 7), hedonism (rank 8), conformity (rank 10) and power (rank 9) yielded the lowest scores for competition participants. That means their behaviour is not guided by a desire to please their loved ones and community. The innovators are not afraid to break existing rules and social norms. Also, they do not wish to obtain and retain power that is not based on their own achievements. This contradicts the Russian population's overall value profile. Russian society has traditionally been characterized as conservative. This is shown by the relatively high scores for the values of security, tradition and conformity: they come in first, fifth and sixth places, respectively. In the value hierarchy of competition participants, the value of tradition comes in seventh place, and the value of conformity comes in last.

5.5 Motivation

After conducting factor analysis on the motivation scale items, we discerned four latent factors that reflect different aspects of motivation: social, financial, status and innovative motives. All factors have good internal consistency and straightforward interpretation. The Russian sample deviated from the original set of factors, the main difference centring on a distinct disposition we called "innovative".

Social motivation (3 items, alpha 0.74): this type of motivation reflects a person's propensity to help others, improving existing rules or course of business. A start-up or innovation driven by a leader with high values of these factors would tend to be a social entrepreneurship. In terms of Schwartz's values theory, it could be paralleled with benevolence and universalism.

Status motivation (5 items, alpha 0.81): this kind of motivation is related to gaining status and seeking a challenge at the same time. So it is not only about being respected or famous, as it is associated with being awarded for one's achievements, worthy recognition. Individuals wish to be recognized, and they are ready to work

hard to get this recognition. This type of motivation can be *inherent* to both social and business innovation start-up. It is close to Schwartz's stimulation and achievement.

Financial motivation (4 items, alpha 0.85): this third factor relates to gaining financial stability and flexibility for personal life through the same. It may, for instance, be about launching a project for earning money, but it also has a component of being independent. In Schwartz's theory it is a combination of self-direction and power.

Innovative or personal fulfilment (4 items, alpha 0.65): the fourth type of motivation depicts a propensity for innovation. On the one hand, persons with this trait are driven by the will to create and bring their innovative ideas to life. On the other hand, it also reflects the importance attached to independence and self-direction. In accordance with Schwartz's theory, this factor is close to self-direction and stimulation simultaneously.

All four factors can be understood as latent qualities that characterize our respondents. Some descriptive statistics for these four traits are described in graphs below (Fig. 5.4). All means are highly positive, especially those of social (5.9, st. dev. 1.09) and innovative (5.7, st.dev. 1.04) motivations. Therefore, innovators tend to agree that these kinds of reasons were important for them when they invented an idea or launched an innovative project. The distributions in graphs (Fig. 5.4a–d) suggest that all respondents are highly motivated by social and innovative motives, and almost no participants had low scores on these scales.

Financial and status motivations also have high mean values (4.1, st.dev. 1.52 and 4.5, st.dev. 1.31, respectively). However, greater variation is shown in graph 5.4a, c. With regard to launching the project, innovators are less consistent on their financial and social status. In addition to the social orientation, it also may be the case that people inside the educational system create innovative ideas and do not treat their activity as something outside their usual workplace or as an external project. If we compare these findings with the previous year's results, we find the same ranking. Those motivational aspects appear to be driven by such values as benevolence and universalism; self-direction is highly important and specific for all innovators. Stimulation and achievement did not yield high absolute scores, but they were more inherent to innovators than to the Russian population, as a whole. This level of disposition appears to be sufficient to serve as the trigger of innovation activity.

Table 5.1 reveals the strength of the relationship between those four traits.[4] The relationship between status and financial motivation is quite high (0.61) and stays high even when partial correlation controlling two other variables is computed. Financial motivation has a rather weak association with the innovative motivation (first order correlation is 0.38, but it drops seriously when controlling with status motivation: 0.12; still it is statistically significant). Both are related to status

[4]We computed Pearson correlation coefficients for assessing the relationship. We also checked for the robustness computing partial correlations. Robust correlations are in bold.

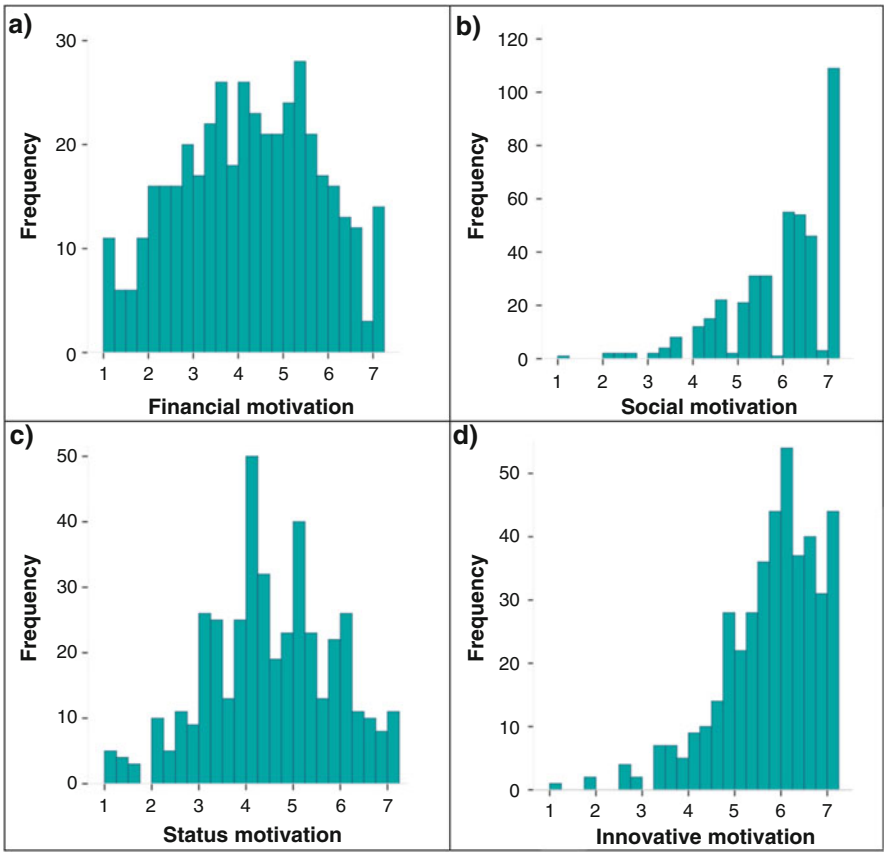

Fig. 5.4 Distribution of the four motivations—(**a**) financial, (**b**) social, (**c**) status and (**d**) innovative

motives. From this finding, we may conclude that they are correlated only through their own associations with the status motivation. Such are examples of different triggers for the project launching; they rarely dominate in one project or in one person at the same time. For those innovators who are motivated by financial rewards, the project unlikely would be pushed by innovative kind of reasons and vice versa.

As for relation between social and financial motivations, they initially have low value (0.17) and become statistically insignificant when controlling for other types of motivation. Innovative motivation suggests a robust, moderate association with both social and status motivations. Social and status motivations are also moderately correlated.

According to the aforementioned results, two groups of innovators can be assumed. The first is more business oriented, and second one suggests a social entrepreneur profile. Herewith, social motivation is inherent to both groups, but for

Table 5.1 Correlation between different aspects of motivation

	Social	Innovative	Status
Financial	0.17 (0.001)	0.38 (0.00)	**0.6 (0.00)**
Social		**0.36 (0.00)**	**0.29 (0.00)**
Innovative			**0.5 (0.00)**

the first one, it pairs with financial motives, whereas for the second, it stands as unique trigger for an innovative project. Status motivation is built-in in social and business groups as well. So for them motivation contains a challenge and a wish to be awarded.

5.6 Examples of Different Motivation in Innovation: Key Cases

Three brief descriptions of innovative projects from the competition illustrate the distinct motives that triggered them. An example of *symbiosis of business and social motivation* is the *Moscow through the Engineer's Eye* project (MTEE), an educational project which aims to promote the history of Moscow's architecture and structural engineering in Russia and beyond among children and adults. The project includes several kinds of activities: tours, lectures and workshops for children and their parents. The project team organizes architectural tours, as well as lectures about the history of structural engineering. The tours are available in Russian and English. Part of the project promotes famous Russian engineers and the history of their home cities among Moscovites and the citizens of Saint Petersburg. An important part of the project is DIY, in which tutors organize children workshops that promote the creation of different structures like Da Vinci Bridge or Shukhov Tower. During this workshop, children go through the various steps of project design, from studying theory—through modelling to construction of a huge structure. Workshops also include introducing new approaches to product design like 3D printing and laser cutting. MTEE is a commercial project. Profit is generated by selling tickets to tours, lectures and workshops. The project has a broad network of partners including public and private schools and festivals. However, MTEE is always eager to participate in collaborative projects with universities or charity foundations seeking to help children understand the world around them also to attract them to the STEM professions.

A typical *socially motivated enterprise* is lifestyle (Obraz zhizni)—a group that helps students from orphanages learn skills needed for independent life. Lifestyle is a sustainable social enterprise. The main idea of the project is to provide a safe environment for young people to explore and experiment with diverse ways of living through communication with a people who represent a diverse range of professions by means of excursions and workshops. According to the lifestyle philosophy, people should choose not only their place of work but also their lifestyle because that choice is not a one-time decision but a lifelong process. The project is implemented by creating urban camps. The programmes last from 2 to 7 days and take place in hostels in the very centre of the city. The target audience of

the programme includes adolescents from 13 to 18 years old both from families and orphanages. Programmes for an underserved audience are conducted in collaboration with a charitable foundation and are adapted specifically to participants. Organizers do not profit from the project. These are two different types of programmes. In the first case, participation is covered by parents or the participants themselves, and these funds are used to pay participation for orphans. In the second case, they use profits from commercial programmes as well as for fundraising.

An example of a *business-oriented project* is Knowledgeville (Znanika), an online service for K-12 education. The project mission is to provide courses, Olympiads and competitions for students online. The website includes math, informatics (computational thinking) and Russian language contests. The math club and online lessons from Knowledgeville help teachers provide e-learning in the classroom. Services for families facilitate parental involvement in the educational process and improve student achievements. Finally, the project allows Generation Z to study in a setting familiar to modern children, to communicate on social networks and to compete online. Innovative technologies unite traditional handwritten classwork with innovative media. The project brings together teachers and tutors who have worked with talented children for decades. Knowledgeville employs a freemium-based model, and service is generally provided free of charge, but money (premium) is charged for proprietary features, functionality or virtual goods. Over the last year, the company has grown by more than 5.5 times, reached 500 thousands registrations.

5.7 Conclusion

Socio-demographic characteristics offer us the general picture of innovators in education. Most of the grassroots innovators have a high level of education, plus work at educational institutions at various levels, and a greater share comes from tertiary education and schools then from organizations not directly related to education. Nonetheless both groups are ready to propose and implement innovations in the field of education. It is important to mention that shares of project spheres and participants' occupations are not directly intersected. For example, there are few people from vocational education; however, this sphere was one of the most popular for project implementation. To better understand the innovators in education, we employed two-step approach. First, we studied the value orientations as it is one of the most crucial personal characteristics that determine person's behaviour. Second, we addressed specific environmental factors, studying the motives which drive person's willingness to create innovative project in the field of education and at the same time how closely those motives are tied to values.

Participants in the competition differ from the Russian population as a whole in their value priorities. Innovators are much more committed to the values of universalism, benevolence and self-direction in their actions and judgements than population of Russia as a whole. According to the results of a nationwide sample

taken across Russia, self-direction, benevolence and universalism are not the values that the population finds to be most significant. In addition, the values of tradition and conformity, which largely guide the lives of average Russians, are not significant for the innovators in the field of education. They are characterized by a willingness to help society's development, to make the lives of others better and also to be awarded for that. The innovators are open to new experiences and ready to take risks.

The study also showed that the four main motives that drive innovators are social, status, innovative/personal fulfilment and financial. They all connected with the broad values in Schwartz' values theory: social with benevolence and universalism, status with stimulation and achievement; financial is a combination of self-direction and power, and innovation reflects self-direction and stimulation simultaneously. Speaking about innovative motivation, its appearance as a distinct disposition is a unique result, which was not revealed in the previous studies of social and business entrepreneurs. Based on innovators' motivational orientations, we can identify groups of innovators with more pronounced business orientation, while social and innovative traits are inherent to all the participants.

5.8 Discussion

The results of this study suggest that there is a core of specialists inside the educational system who are ready not only to accept reforms "from above", but also to act as a "change agent" (Fullan 2007). They are independent in judgement and action, ready to meet difficulties and overcome them on their own. These characteristics differ from the majority of Russian population. Being inside the education system, they are familiar with the rules, understand localized needs and perceive existing gaps, all of which suggests that innovators from within can play a crucial role in system development. However, nowadays it appears as if the Russian education system is only oriented from the top to bottom and not vice versa. As far as support mechanisms are concerned, there is only monetary distribution, which is driven by a very narrow scope of initiatives predetermined by government; thus the potential activity of innovators that does not match governmental requests is undervalued. There is no environment to gather ideas and even hear the voices of these grassroots innovators.

Innovators in education exist not only within the system, but also from without. Many innovative projects represent spheres beyond the scope of formal education, for example three cases described above. One of them, "Moscow through the Engineer's Eye", has a broad network of partners including public and private schools but organizes activities independently. Excursions' content is not related to school programme. One possible explanation for this is that the existing curriculum is very traditional and covers only time-honoured topics; contemporary knowledge and skills are left behind, niche that is occupied by innovators from without. Realizing the importance of the twenty-first century skills, parents and students are ready to pay for any educational activities with contemporary and interesting

format and content. Another reason is that even if one is relevant to the traditional curriculum innovative idea, it is rather difficult to embed it into the existing educational system. Schools and universities are not ready to collaborate with external people; they see them as aliens. In such circumstances, innovators prefer to act from outside. Moreover, these boundaries affect innovators from within in the same way as innovators from without, encouraging them to contribute into the system from outside.

Innovators from both sides of education, guided by the needs of others, even if they represent business-oriented project, they always have a social mission. All projects submitted to the competition aim to develop the education system by making it more effective, available to a broader audience, more innovative in terms of teaching methods, more open to ICT and blended learning, etc. All innovators need support in their innovative activities, a sense that they are needed in education. Such supports not only assume monetary compensation, but also an environment in which they can create and develop their ideas at the early stages of the project. Creation of environment that nurtures the spread of grassroot innovations has intrinsic value for education. Deepening the process of education's opening up is a means to upgrade the educational system, and integrating into the system something extrinsic will lead the system to be renewed.

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Identifying Factors Associated with the Survival and Success of Grassroots Educational Innovations

6

Ivan Smirnov

6.1 Innovations Are Everywhere

The word 'innovation' became an indispensable constituent of contemporary discourse. One can find it everywhere from advertisements of consumer goods to political speeches. Over the past 70 years, the use of the word 'novelty' remains stable, while 'innovation' has seen a sixfold increase (Google 2016). In the 2000s, this word could be heard during UK parliamentary debates ten times more often than in the 1960s (Perren and Sapsed 2013). Such overuse inevitably leads to the word's devaluation. A mere enhancement of a razor blade is called 'innovation' by its manufacturer; the improvement that can be hardly put on a par with the invention of printing press, electricity or antibiotics.

Nevertheless, its 'buzzword' reputation does not undermine the key role of innovation in economic development. As Joseph Schumpeter, the father of innovation economics, asserted, sustained long-term economic growth is impossible without ceaseless process of innovation (Schumpeter 1942), noting that 'add successively as many mail coaches as you please, you will never get a railway thereby' (Schumpeter 1934). Today it became evident that the same rule is applied to education. It is increasingly challenging for education to stay relevant in such rapidly changing environment as modern world, and the only way for it to keep up with these changes is through innovation (Taddei 2009).

Education is often considered to be a conservative and outdated field, but this statement is disputable. Many, including Sir Kenneth Robinson (2010) and Salman Khan (2012) in their popular TED talks, argue that modern educational system is a progeny of industrial revolution with the sole aim to train well-disciplined and docile citizens. In fact, the origins of the public education system can be traced to

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humanistic ideas and practices introduced by Comenius a century before industrial revolution (UNESCO 1999).

It is not unusual for education to be ahead of its time and to determine the future. The first female student was admitted to the University of Zurich at the same terms as men in 1867 (Simonton 2006). Only one hundred years later Switzerland gave its women the right to vote. In many developed countries, women reached parity with men in education, while there is still a gap in job market and politics. Some educational institutions had a major impact on whole industries as the famous art school Bauhaus that had a profound influence on modern design (Pevsner 1999). Finally, according to a recent OECD report, education by some measures is the second most innovative sector after manufacturing (OECD 2014).

6.2 Evidence-Based Policy for Grassroots Educational Innovations

To no surprise there is an increasing interest and demand for the study of innovation in education. While there is a growing number of literature about innovation both in private and public sectors, there is still a gap in our understanding if these findings can be applied to the field of education. One particularly underexplored area is grassroots innovations. Governmental reforms and top-down initiatives are often monitored by research institutions, but grassroots innovations in education escaped the attention of researchers so far. At the same time, it was argued that there is a great promise in such innovations, especially at the time when thanks to new technologies, availability of capital and increasing number of people with entrepreneurial skills and ambitions, it became possible for teachers, students and ordinary citizens to take on challenges that in the past were reserved exclusively for governments and large organizations (UNICEF 2015). The importance of such social entrepreneurial projects is emphasized by many authors (Christensen et al. 2006; Dees 2007; Reimers 2010).

In this paper we present results from an empirical pilot study that aspire to identify factors associated with the survival and success of educational grassroots innovations in a Russian context. The term ‘innovation’ was popularized in Russia in 2008 when Dmitry Medvedev was elected as president of Russia with the promise to modernize the economy by focusing on four ‘I’s: institution, infrastructure, innovation and investment. At the same time, the first post-soviet generation reached young adulthood. These people had an entrepreneurial mindset and desire to make the world a better place. Thus, the stage was set for the rise of Russian start-ups. One prominent example from that time is the social network site VK that became the largest social network in Europe. In 2010, hackathons, start-up weekends and other events for aspiring entrepreneurs spread. In large cities like St. Petersburg or Moscow, they are held almost on a weekly basis nowadays. Business incubators were opened in many universities including ITMO University, Moscow State University and Higher School of Economics. In 2013, Impact Hub Moscow, an accelerator for social entrepreneurs, was launched. In 2014, Digital

October hosted EdCrunch, the first conference on technology and education in Russia. At the same year, the Institute of Education organized a competition for innovators in education—KIVO (Competition for Innovations in Education) that attracted more than 500 applications. The demand for study innovations in education is now matched with sufficient amount of empirical data in Russia.

We use data from 240 applications of KIVO participants who completed a follow-up survey one year later, in 2015. We identify factors that are associated with the project's survival and success and build a predictive model. The generalizability of the model was tested on data about 250 participants of KIVO 2015 and the status of their project in 2016. We also compare predictive power of our statistical model with predictive power of experts' evaluation.

6.3 Pragmatic Definition of Grassroots Innovation

The term 'innovation' is known to be notoriously ambiguous and lacks a single definition (Adams et al. 2006). While business remains the main domain where the term is used it is now common in public sector too. In particular, OECD adapted its definition of 'innovation' from Oslo Manual (OECD 2005) for the use in educational contexts (OECD 2014):

> Educational organizations (e.g. schools, universities, training centres, education publishers) introduce (1) new products and services, e.g. new syllabi, textbooks or educational resources (2) new processes for delivering their services, e.g. use of ICT in e-learning services, (3) new ways of organising their activities, e.g. ICT to communicate with students and parents, and (4) new marketing techniques, e.g. differential pricing of postgraduate courses. These new practices are intended to improve the provision of education in one way or another, and therefore, innovations in education should be regarded as "improvements".

However, it remains unclear which changes should be considered as improvements, especially if they are beneficial for one group of stakeholders (e.g. high-income families) but not for another (e.g. low-income families). It is also unclear which improvements are significant enough to be called 'innovation'.

As a result of such ambiguity, a wide range of practices is called innovation in literature, including the use of learning management system in university courses (Soffer et al. 2010), student internship abroad (Spiering and Erickson 2006), change in time spent on lecture-style presentations in classrooms (OECD 2014), etc.

In our work we use a pragmatic definition of grassroots innovation. We base it on a simple fact that when decision makers are required to evaluate an educational initiative, they have to assess its viability and potential impact regardless of whether this initiative meets one or another formal definition of innovation. For the purposes of this research, we call 'grassroots innovation' any educational project initiated by a teacher, a student, an aspiring entrepreneur or an ordinary citizen, who work on it alone or in a small team and call this project 'an innovation'.

6.4 Survival and Growth as Proxies of Innovation Success

Most of the grassroots innovations fail before they achieve any impact or become adopted by a significant number of people. Nascent entrepreneurs often discover that they lack sufficient resources to make their project viable; they may discover that their initial idea doesn't work or they may change their personal priorities before the project becomes self-sustained (Cooper et al. 1994). The survival of a project is, therefore, the key metric to evaluate educational innovation at early stage.

If a project survives despite of the potential obstacles then the natural way to measure its success is to use growth as a proxy (Carter et al. 1996). Growth can be measured in the number of end users, number of employees or as completion of certain stages such as creating a prototype, achieving positive cash flow, etc. These stages are significantly linked to the probability of eventual success (Edelman et al. 2008).

6.5 Potential Predictors of Innovation Success

In our work we investigate factors that are associated with the survival and success of grassroots educational innovations that were part of KIVO competition. We base our hypotheses upon the most widely used theoretical framework in innovation studies: Rogers' diffusion of innovation theory (Rogers 1983). The framework is common in educational context (Shea et al. 2005; Warford 2005; Spiering and Erickson 2006; Soffer et al. 2010).

Diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers 1983, p. 5). It means that the successful diffusion of innovation depends not only on its own characteristics but also on characteristics of social environment and characteristics of change agents (p. 312).

According to Rogers, the following characteristics of innovation are related to its eventual success: relative advantage, compatibility, simplicity (complexity), trialability and observability (ibid, p. 14). We expect that all of these characteristics would be positively correlated with the survival and success of KIVO projects (Hypothesis 1). As the environment plays an important role in diffusion of innovations, we expect that the project that operates in a more open and less regulated environment such as extracurricular activities should have more chances to survive or succeed than projects within compulsory education system (Hypothesis 2).

The importance of human capital for entrepreneurial success was shown in numerous studies (Shane 2000; Marvel and Lumpkin 2007; Ucbasaran et al. 2008). We expect that the level of education of project team members and their experience would be closely connected with the success of their projects (Hypothesis 3). As the social capital of entrepreneur also contributes to the project success (Davidsson and Honig 2003), we expect that the team size and amount of its social activity would be positively correlated with success (Hypothesis 4). We expect that teams with entrepreneurial experience would outperform teams without such experience. We also expect that projects of self-identified entrepreneurs

outperform projects that are led by people who identify themselves as students, teachers, researchers or full-time employees (Hypothesis 5). The importance of entrepreneurial self-efficacy was demonstrated by Chen et al. (1998).

There are two main approaches to decision-making often referred as clinical and statistical methods. In the clinical method, the decision maker combines or processes information in his or her head based on his or her knowledge and experience. In the statistical method, the human judge is eliminated and conclusions rest solely on empirically established relations between data and the condition or event of interest (Dawes et al. 1989). Empirical comparisons of the accuracy of the two methods (136 studies over a wide range of predictors) show that the statistical method is almost invariably equal to or superior to the clinical method (Grove and Meehl 1996). As all of the KIVO applications were evaluated by experts, it becomes possible to compare the predictive power of judges' evaluation with the predictive power of the model built on combination of significant factors. We expect that the statistical approach would provide at least the same performance (Hypothesis 6).

6.6 Empirical Data and Methodology

KIVO is an annual Russian competition for innovations in educations that is designed for early stage projects: more than an idea but less than a self-sustained project. There is no geographical, professional or age restriction for participation. More than 500 projects participated in KIVO in 2014 and more than 600 in 2015. Social and professional characteristics of participants were described by Koroleva and Khavenson (2015). The fact that most of the projects were not launched yet at the time of application helps to eliminate bias that is inevitable for surveys about already operating projects (Caliendo and Kritikos 2008).

Applications to KIVO were submitted in April and May of 2014 (the first wave) and in April and May of 2015 (the second wave) via an online form. One year later in summer 2015, for the first wave, and summer 2016, for the second wave, an online survey was sent to project leaders. 487 invitations were sent, and 240 responses were collected for the first wave; 585 invitations were sent, and 242 responses were collected for the second wave.

Project leaders were asked whether they would continue to work on a project that was submitted to KIVO competition. They were provided with four options: (1) they continue to work on the same project, (2) they work on a new or significantly modified project but within the same team, (3) they work on a new project (related to innovation in education) within a new team and (4) they do not work anymore on anything related to innovation in education.

The first and the second options are considered as survival. While in the case of the second option where the team may work on a different project, it can be considered as continuation of their previous work and typically called a 'pivot' in entrepreneurial literature (Blank 2013). The third and the fourth options mean that

the project did not survive. There were 180 survived and 60 not survived projects in the first wave and 190 survived and 52 not survived in the second wave.

Among projects that survived, we additionally identify successful projects, namely, projects that launched a pilot or started production of a product, hired new employees or significantly (1.5 and more times) increased number of end users. There was scarce and inconsistent data on cash flow, investments and other financial characteristics, and it was consequently excluded from analysis. As a result of this designation, projects that moved to a new stage or achieved significant growth are considered as successful, while stagnant projects are considered as unsuccessful. Ninety-six out of 180 projects were successful in the first wave and 104 out of 190 in the second wave.

Note that leaders of survived projects completed an additional survey about their projects and that is why more information was available for analysis of factors associated with success than for analysis of factors associated with survival.

To determine whether Rogers' characteristics of innovation are associated with the survival and success of educational innovations (Hypothesis 1), project leaders were asked to assess trialability, compatibility, complexity and relative advantage of their projects (see Table 6.3 in Appendix for corresponding questions).

To study the effect of different environments on innovation success (Hypothesis 2), we compare innovations from large cities (Moscow, Saint-Petersburg) with innovations from smaller cities and innovations from different domains such as kindergarten, primary school, middle school, high school, university, extracurricular activities, professional education and family education. When asked about the domain of their innovation, project leaders were allowed to choose several options simultaneously.

To access the impact of human capital (Hypothesis 3), projects leaders were asked about the highest level of education of all team members and were asked to name universities from which they graduated. They were also asked if any of the team members studied or worked abroad for at least 3 months. In addition to past experience, they were asked about recent (during the last year) educational activities related to their project, including completing online courses, reading professional literature, looking for relevant research, studying competitors and existing analogues of their project.

The social characteristics of the team (Hypothesis 4) include team size, presence of mentors and also activities during the last year such as attending relevant events, participating in competitions and discussing project with experts.

Team members were asked about the domain of their current activities: education, entrepreneurship or industry. We distinguish teams with a leader who is a self-identified entrepreneur and teams that have at least one self-identified entrepreneur (Hypothesis 5).

Finally, we include having a project website at the time of application to KIVO as an additional variable of interest in our analysis.

There was a two-step procedure in the jury evaluation of KIVO applications. At the first stage, the expert chooses one of three options: (1) project does not deserve further consideration, (2) project should be considered according to the general procedure and (3) project deserves a special attention. If the second or third option

is chosen, then the expert assesses the project's novelty, its scalability, significance of the problem it addresses and adequacy of the chosen approach to tackle the problem. These four characteristics are evaluated on the scale from 1 to 5.

For further analysis, all of the factors in question are converted into binary dummy variables, and then the Fisher's exact test (Fisher 1922) is used to identify factors that are significantly associated with project survival and success. This procedure leads to multiple hypotheses testing, and to account for it, we use Šidák correction (Šidák 1967). We choose a threshold of 0.1 for the assembly of variables, which was lowered to 0.015 for 7 independent variables related to the survival and lowered to 0.009 for 11 independent variables related to success. For the factors that are identified as significant, we compute the increase or decrease in odds for survival and success. The odds ratio is a standard way to determine the effect size for binary variables (Edwards 1963; Mosteller 1968).

To evaluate the combined predictive power of identified factors, we use standard machine learning techniques: logistics regression and random forests (Breiman 2001). The quality of the model was evaluated with area under the receiver operating characteristic curve (AUC). AUC is a better measure than accuracy in comparing predictive models (Huang and Ling 2005; Ling et al. 2003). AUC has the following intuitive interpretation: it is equal to the expectation that a uniformly drawn, random survived (successful) project is ranked by the model higher than a uniformly drawn random not survived (not successful). The statistical model was compared with judges' evaluation.

The design of this pilot study implies certain limitations. The data is potentially noisy, self-reported evaluations that may be biased; the choice of survey question despite being grounded in existing literature is still rather arbitrary. Even if the constructed model fits data well, it may have poor generalizability. To check the generalizability of the proposed approach, we cross-validated our model on an independent data set, namely, the model was constructed based on the first-wave data, and the predictive power was then checked on the second-wave data.

6.7 Team Matters More than the Project

Four factors were significantly associated with the survival of the project, and eight factors were significantly associated with the success (see Table 6.4 in Appendix). The respective odds ratio is presented in Table 6.1.

Hypotheses 1 and 2 were not confirmed. Neither characteristics of the innovation nor its environment were significantly associated with the project survival or success. As characteristics of innovations were evaluated by project leaders themselves, it may mean that they are unable to objectively judge their own project. It may also mean that our sample is too heterogeneous to find a significant effect of a single characteristic of innovation.

Unlike the characteristics of the project, several characteristics of the team were significantly associated with project success. In accordance with Hypothesis 3, human capital appears to play an important role in the project prospects. The

Table 6.1 Changes in odds to survive and succeed

Factor	Odds ratio	Factor	Odds ratio
Survival			
Project leader is an entrepreneur	3.49	Team has only one member	0.69
Project has a website	2.77	Project leader is a student	0.35
Success			
Team members has foreign experience	8.41	Attending online courses	2.63
Participating in competitions	3.16	Project leader is an entrepreneur	2.44
Studying competitors and analogues	3.16	Team members include graduates from top universities	2.37
Discussing with mentors and experts	2.71	Participating in events	2.32

least experienced teams (those led by students) were less successful in comparison with other teams (odds ratio is 0.35). At the same time, the teams led by graduates from the top universities were more successful than teams without any graduates from the top universities (odds ratio is 2.37). Foreign experience of team members emerged as the single most powerful predictor of eventual project success (odds ratio is 8.41). It may be the consequence of foreign experience itself as some teams were inspired by projects elsewhere in the world and decided to launch a similar one in Russia. Foreign experience may also be the best proxy for the overall human capital.

Hypothesis 4 was also confirmed. The absence of team partners significantly decreased project chances to survival. Participation in events and discussions with mentors or experts significantly increased its chances to success.

The most powerful predictor of project survival was being led by entrepreneur. The same factor was significantly associated with project success, confirming the Hypothesis 5.

The result of our research is not an exception to the general observation (Hypothesis 6), showing little predictive power of experts' evaluation in respect to project survival or success.

In addition, we discovered that projects that have a website at the time of application had increased chances to survive in 1 year. The entry barriers for participation in KIVO are low as it does not require from applicants to have an already operating project or to provide an evidence of working technology. Some applications are, therefore, spontaneous, without a real commitment from the team to the project. The website turned out to be an effective way to filter such applicants.

Table 6.2 Predictive power of statistical models and experts' evaluation measured as AUC

	Wave 1		Wave 2	
	Data	Experts	Data	Experts
Survival				
Logistic regression	0.76	0.54	0.60	0.55
Random forests	0.60	0.54	0.59	0.54
Success				
Logistic regression	0.91	0.57	0.83	0.58
Random forests	0.82	0.54	0.81	0.54

6.8 Statistical Model Outperforms Expert Evaluation

To estimate the combined predictive power of different factors, we used logistic regression and random forests models. The quality of models was evaluated with AUC, and the results are presented in Table 6.2.

Results indicate that the expert evaluation has little predictive power with respect to project prospects and is easily outperformed by the statistical model. Remarkably, this result holds even after cross-validation; the model trained on 2014 data predicts survival and success of projects from KIVO 2015 better than jury evaluation.

6.9 Discussion

The main result of our study is that data that was gathered from projects at the time of the application to KIVO competition contain enough information to make some conclusions about their chances to survive or succeed in 1 year.

As the study is based on applications to one particular competition, it remains unclear if it can be generalized to educational initiatives in general. On one hand, the diversity of projects that participated in KIVO makes it reasonable to assume that identified factors are important for a wide range of projects. On the other hand, the same diversity does not account for the specificity of certain categories of projects, which may explain why none of the project characteristics was identified as associated with survival or success. If the same characteristic increases chances for success in one category of projects within one environment but decreases chances to success for another category of projects in another environment, then it cannot be identified by our method.

Survey data is inevitably noisy. However, applying the model trained on the first-wave data to the second-wave data provides a safeguard against overfitting and spurious correlations and proves the generalizability of our approach.

The results provide some guidance for the decision-making in the domain of grassroots educational innovations. First, they indicate that it is not enough to base decisions solely on the characteristics of the educational innovation, itself and underscore the importance of a project team. In addition to fixed characteristics of the team, it is important to take into consideration their activities and tangible results of such activities (e.g. a project website).

Second, it was shown that the expert evaluation has low predictive power and is inferior to statistical approach. While in many cases it is infeasible to eliminate human judgement from decision making, statistical models could be used as complementary tools. For example, a predictive model could be used at the first stage of the application selection process to filter the least promising applications and to reduce the amount of work for human judges. It can be used at the very last step as well by selecting the most promising applications among those that were ignored by experts. Such applications might warrant a second chance to be considered by experts. Even if statistical models are not used at all, it is important to validate an evaluation procedure because a mere fact of the experts' presence does not guarantee any predictive of their judgement.

It is important to note that a statistical approach has its own limitations. It is not casual: if some factors are associated with project success, this does not necessarily mean that by influencing these factors one can change a project's chances to succeed. And it can be gamed. For example, if the presence of a website is included in the model and participants know about it, they can create an empty website five minutes before application to formally satisfy the criteria. That would basically reduce the predictive power of this variable to zero.

Our study demonstrates the potential power of data-driven approaches to decision-making with respect to innovations in education. However, the available data is scarce, and there is a clear need for a framework for systematic and longitudinal data collection, its subsequent analysis and its integration into the decision-making process. In the absence of such a framework, decisions to support one or another initiative remain highly arbitrary. The framework would be an important step towards evidence-based policy in the field of educational innovation.

Appendix

Table 6.3 Survey questions related to Rogers' characteristics of innovation

Rogers' characteristic	Question
Trialability	*How much time do users need to spend before they can actually start to use your product, service or method?* • Several minutes • Around one hour • Several hours • Several days • A week or more • Impossible to estimate
Compatibility	*The use of your product, service or method* • Complement an existing practice and do not require its abandonment • Require partial abandonment of an existing practice • Completely substitute an existing practice and require its abandonment

(continued)

Table 6.3 (continued)

Rogers' characteristic	Question
Complexity	*The time of a single use of your product, service or method* • Several minutes • Around one hour • Several hours • Several days • Several months • Other or impossible to estimate
Relative advantage (labour)	*How much does your product, service or method decreases labour effort compared with alternatives?* Scale from 1 to 5
Relative advantage (interest)	*How much does your product, service or method makes the work or the study more engaging comparing with alternatives?* Scale from 1 to 5
Relative advantage (effectiveness)	*How much does your product, service or method makes the study more effective?* Scale from 1 to 5

Table 6.4 Association of factors with survival and success

Factor	*p*-value	Factor	*p*-value
City		Project leader	
Survival			
Moscow	1.000	Student	0.001*
St. Petersburg	0.427	Entrepreneur	0.004*
Other	0.276	Teacher	0.563
Domain		Full-time employee	0.847
Kindergarten	0.082	Other	0.351
Primary school	0.316	Team has	
Middle school	0.881	Entrepreneur	0.056
High school	0.881	Teacher	0.457
University	0.210	Full-time employee	0.016
Extracurricular	1.000	Jury evaluation	
Professional	0.086	Overall	0.769
Family	0.051	Novelty	0.405
Other	1.000	Importance	0.822
		Relevance	0.560
Project has website	$<10^{-5}$*	Scalability	0.795
Only one team member	0.002*		
Success			
Moscow	0.039	Jury evaluation	
St. Petersburg	0.277	Overall	0.631
Other	0.207	Novelty	0.648

(continued)

Table 6.4 (continued)

Factor	*p*-value	Factor	*p*-value
Domain		Importance	0.364
Kindergarten	0.841	Relevance	1
Primary school	0.870	Scalability	0.449
Middle school	0.651	Rogers' characteristics	
High school	0.175	Complexity	0.626
University	0.331	Trialability	0.296
Extracurricular	0.072	Compatibility	0.294
Professional	0.104	Relative advantage (labour)	0.104
Family	0.388	Relative advantage (interest)	0.294
Other	0.831	Relative advantage (effectiveness)	0.829
		Activities	
Project has website	0.015	Participating in events	0.002*
Only one team member	0.268	Completing online courses	0.001*
Project leader		Reading professional literature	0.270
Student	0.800	Looking for relevant research	0.059
Entrepreneur	0.004*	Studying competitors and analogues	0.002*
Teacher	0.849	Discussing with mentors and experts	0.001*
Full-time employee	0.701	Participating in competitions	0.007*
Other	0.717		
Team has		Team members include graduates from top universities	0.009*
Entrepreneur	0.046	Team members have foreign experience	$<10^{-5}$ *
Teacher	0.296		
Full-time employee	0.443		

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Understanding Technology Integration Failures in Education: The Need for Zero-Order Barriers

7

Ilias Karasavvidis and Vassilis Kollias

7.1 Introduction

The idea that technology would revolutionize the classroom has a century-long history. Western world classrooms have experienced successive technology waves such as radio, film, and television (Cuban 1986). The availability of personal computers in the early 1980s marked the beginning of the computer era, leading to the widespread introduction of information and communication technology (ICT) in educational systems. For the past three and a half decades, educational reformers have attempted to transform education through technology without much success. This failure is characterized by two main dimensions: extent of use and type of use.

7.2 The Problem of Low Frequency of ICT Use

Technology cannot revolutionize the classroom unless teachers use it. As the literature suggests, the rate of ICT use in the classroom is rather low. While teachers do employ ICT, they use it more for personal reasons rather than for supporting learning. More specifically, research shows that teachers use ICT for administrative purposes as well as personal preparation and support (Eteokleous 2008; Gray et al. 2010; Zhao and Frank 2003). Based on the study of technology use in 19 US schools, Zhao and Frank (2003) found that while 80% of the teachers reported daily use of computer technology, this use actually included communication with parents

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and preparation for instruction. In the latest US national survey, Gray et al. (2010) report that more than 90% of the public school teachers in their study used technology frequently for entering grades and attendance records. Productivity applications, the Internet, and administration applications are indeed the dominant types of software use in schools (Gray et al. 2010). In a study of Cypriot teachers, Eteokleous (2008) also found that teachers use computers extensively for personal use.

When it comes to technology use in the classrooms, studies show that classroom use grows at a slow rate and with unequal pace, depending on the context. Studies published since 2000 indicated that, even at the beginning of the twenty-first century, the rate of technology use in classrooms was low. In a survey of 4000 K-12 US teachers, Norris et al. (2003) reported that nearly half the teachers used technology for about 3 minutes a day. Similar low rates of use were reported by Webb and Cox (2004). The findings of more recent studies also suggest that teachers still use ICT rarely in their classroom practices (Hinostroza et al. 2011; Ward and Parr 2010; Wikan and Molster 2011). National studies also report similar patterns of relatively low ICT use, e.g., Norwegian teachers (Wikan and Molster 2011) and Chilean teachers (Hinotstroza et al. 2011). It should be noted, however, that recent international large-scale comparative studies suggest an increase in the rate of classroom use of technology (Law and Chow 2008; Fraillon et al. 2014). More specifically, Fraillon et al. (2014) concluded that three out of five teachers use computers at least once a week for teaching purposes. A US national survey shows similar findings, as 40% of the public school teachers reported that they or their students used computers often (Gray et al. 2010). Other studies also confirm an upward trend in terms of frequency of use across time (Cuban 2013).

7.3 The Problem of the Type of ICT Use

The most consistent finding of more than three decades of research is that technology has failed to transform teaching and learning practices. On the one hand, this finding is consistent in surveys examining the types of ICT use by teachers and students. More specifically, the Second Information Technology in Education Study (SITES) indicated that ICT adoption does not necessarily mean that traditional practices are abolished (Law 2008). Several national studies also provide similar evidence, e.g., in the UK (see Selwyn 2008; Yang 2012; British Educational Communications and Technology Agency (BECTA) 2008) and Ireland (McGarr 2009). In a survey of 19 US schools, student technology use, as reported by teachers, involved learning and practicing basic skills (69%), conducting research (66%), and word processing (61%) (Gray et al. 2010). Drawing on survey data from 35,000 teachers in 21 countries or educational systems, Frailon et al. (2014) conclude that teachers mainly use ICT for presenting information and reinforcing skills, while students typically use ICT for information searching and short assignment completion. The authors argue that the dominant pattern of use that emerges is the use of technology for relatively simple tasks.

On the other hand, studies that examine the rationale behind the learning environments that teachers design, suggest that, as a rule, technology is incorporated into existing practices rather than transform them. Consequently, despite technology integration, traditional practices are still dominant (Hermans et al. 2008; Law and Chow 2008; Player-Koro 2012) and even reinforced (Donnelly et al. 2011). More specifically, most teachers in the Hayes's (2007) study reported that ICT had not changed the ways in which they teach or the ways they design learning experiences for their classrooms. Van Braak et al. (2004) also concluded that only few teachers used technology as a learning device. Similarly, the majority of the teachers surveyed by Prestridge (2012) were simply adding ICT to the existing curriculum. Li (2007) found that computers were being used mostly as improved typewriters or simply for demonstration purposes. Finally, Eteokleous (2008) also reported that computers are used in classroom as "fancy chalkboards." Despite the fact technology has not transformed current teaching practices, the clear but slow evidence of progress has been acknowledged (Voogt 2008; Cuban 2013).

7.4 Conceptualizing Solutions

Why teachers neither enthusiastically embrace technology nor exploit its high-added learning value has remained a mystery. Theorizing and empirical research has led to two main conceptualizations of the problem, which we refer to as *pragmatic* and *historical*. The pragmatic conceptualization has been advanced by Ertmer and colleagues (Ertmer 1999, 2005; Snoeyink and Ertmer 2001). We refer to this conceptualization as pragmatic because it represents a tangible, rational, and layered approach to determine what gets in the way of using ICT in educational practices. The pragmatic conceptualization has been the dominant view over the last 15 years. Following Rasmussen and Ludvigsen (2009), we refer to the alternative conceptualization as historical. The historical approach has been put forward by Cuban (2001, 2013) and others (notably Tyack and Tobin 1994). This conceptualization stresses the importance of taking contextual factors into account in order to understand the problem of ICT uptake. While the historical conceptualization has a longer history, it has received less attention.

7.5 Pragmatic Conceptualization

In this section we will introduce the pragmatic conceptualization of the problem of ICT integration. The pragmatic approach conceptualized technology integration problems in terms of first- and second-order barriers (Ertmer 1999, 2005; Snoeyink and Ertmer 2001). This conceptualization has provided useful guidance with respect to integrating ICT in classrooms. Its core concept is the one of the barriers to ICT use. Factors affecting whether ICT gets used or not are distinguished into two types of barriers: first-order and second-order ones (Ertmer 1999, 2005; Snoeyink and Ertmer 2001). Typically, *first-order barriers* involve factors extrinsic

to teachers, namely, factors that are beyond their direct control. Such factors include (a) *infrastructure* (Norris et al. 2003; Eteokleous 2008; Granger et al. 2002), (b) *technical support* (Hayes 2007; Penuel et al. 2007), (c) *time for planning and experimentation* (Clouse and Alexander 1997; Snoeyink and Ertmer 2001), (d) *administration/leadership* (Perrotta 2013; Law 2008; Hayes 2007; Yee 2001), (e) *collaboration among teachers* (Sandholtz and Reilly 2004; Cuban 2013), and (f) *teacher training in ICT use in education* (Eteokleous 2008). As the literature suggests, all the aforementioned factors influence both the rate and the nature of technology integration in classrooms.

On the other hand, *second-order barriers* are intrinsic to teachers and address the willingness and competence of teachers to integrate ICT in their lessons: teachers' beliefs about the value of teaching with technology, their knowledge of ways to integrate ICT in their classroom, their general ICT competence, the instructional models they endorse, and their openness to change. Second-order barriers include

(a) *Teacher background variables* such as age and gender, academic qualifications, pedagogical ICT competence, and orientation to progressive pedagogies (Law and Chow 2008),
(b) *Teacher perceptions of the value of ICT in teaching and learning* (Ward and Parr 2010; Eteokleous 2008; Mueller et al. 2008; Van Braak et al. 2004; Baggott la Velle et al. 2004; Dexter et al. 1999),
(c) *ICT competence/feelings of efficacy with respect to ICT use* (Mueller et al. 2008; Wood et al. 2005; Prestridge 2012; Eteokleous 2008), and
(d) *Teacher beliefs about teaching and learning* (Hermans et al. 2008; Van Braak et al. 2004).

The conceptualization of barriers in terms of first- and second-order ones represents a major step forward in identifying the problem of ICT uptake and taking measures to address it. Nevertheless, we argue that the pragmatic conceptualization is characterized by three major limitations. First, the distinction between first- and second-order barriers is not always clear. Second, this conceptualization is typical of what is called individual-blame bias (Rogers 2003). Teachers are essentially victimized, as the failure to utilize the potential of technology has been attributed to them. Third, the pragmatic conceptualization accepts a simplified account of teacher agency.

Regarding the first, drawing a sharp line between internal and external factors might not be very straightforward. Snoeyink and Ertmer (2001) pointed out that some of the first-order barriers three experienced teachers reported when using ICT (e.g., inadequate preparation for using computers) may actually be masked second-order barriers. Mueller et al. (2008) concluded that specific, task-relevant, and classroom applicable experiences with technology facilitate technology adoption. The authors point out the boundary nature of such experiences, stressing that they are neither external (since they have to be reflected upon) nor internal (since they are enacted in the classroom). On the other hand, the complex relation between teacher beliefs and practices also reflects the problematic nature of association

between first- and second-order barriers. For example, Sandholtz and Reilly (2004) report that it is unclear if technology use leads teachers to shift toward constructivist practices or if constructivist beliefs lead teachers to adopt technologies. Ertmer (2005) also argues that change in beliefs follows rather than precedes change in practices. Last, the distinction between teacher-related and teacher-unrelated barriers might not be the most appropriate. For instance, Spillane (1999) observed that when faced with the same innovative mathematics curriculum, two teachers who were equally willing to conform differed markedly in terms of how much their core practices changed. To account for this differential response, Spillane (1999) proposed a unit of analysis that extends beyond the individual teacher. Overall, such findings are difficult to explain by simply resorting to first- or second-order barriers, namely, without an examination of historical, structural, and contextual factors.

Regarding the second limitation, teachers are seen as the key to resolving the problem of ICT integration. This is clearly reflected in the main assumption underlying the pragmatic approach: eventually, it is classroom teachers who get to decide whether and how to use technology (Ertmer 2005). The problem with this assumption is that it considers changing teacher conceptions to be the main leverage point for achieving a solution. However, changing teacher views might not necessarily result in a change in the corresponding teacher practices. This pragmatic conceptualization portrays teacher views as resulting from teachers' own free choice. While on the surface such a view stresses teacher agency, in reality it leads to the victimization of teachers: they are bound to be held accountable for any technology adoption failures. On a broader level, the literature on innovation diffusion also suggests that the "individual-blame bias," i.e., putting the blame on individual teachers, is rather common (Rogers 2003).

Lastly, the pragmatic conceptualization assumes a rather simplified account of teacher agency. According to the main assumption underlying the pragmatic approach, the stepwise resolution of the first-order barriers, initially, and of the second-order ones, subsequently, is self-evident. However, implementing a solution based on this assumption will not lead to success as the issue of teacher agency is complicated. For instance, drawing on Lortie and Clement's (1975) work, Hargreaves' (2010) concluded that the relation among teacher individualism, presentism, and conservatism is very elaborate because it is being mediated by teacher agency. Moreover, his review showed that similar stepwise reform efforts, aiming to diminish the conservatism of teachers' practices, are mired in unintended consequences.

To address these limitations, we will reconceptualize the pragmatic approach by drawing on concepts from two frameworks. First, we will introduce a historical conceptualization of the problem of ICT innovation and educational reform.

7.6 Historical Conceptualization

The historical framework provides an insightful way of looking at the problem of ICT uptake in education. This approach considers ICT innovation as a special case of reform. We draw on two particular sources for presenting the historical approach. The first source is the concept of the "grammar of schooling" introduced by Tyack and Tobin (1994). To account for the repeated failure of innovations to reform schools, the authors introduce the concept of the "grammar of schooling." This grammar constitutes the regularities that organize educational practices and involve structures and rules that regulate teachers and teaching such as the graded school, the self-contained classrooms which separate teachers and students, a curriculum that is divided into segments of knowledge and skills, curricular structures for specific age groups, a schedule which brings teachers and students together only for small periods of time, and departmental teaching which separates teachers of different academic subjects.

Through an insightful historical analysis of reforms, Tyack and Tobin (1994) document how the current school structure may be accounted for by two major innovations rooted in US education, in the early twentieth century, the *graded school* and the *Carnegie unit*. Inspired by the division of labor in factories, the graded school involved teachers teaching the same curricular subjects to a single grade in the same way and at the same time. Compared to pre-existing practices, this organizational measure afforded much greater efficiency. The second innovation that emerges as critical from Tyack and Tobin's (1994) historical analysis is the *Carnegie unit*. This unit was defined as a course of five weekly periods (each lasting up to 55 minutes) throughout an academic year. Initially meant to set the standards for university entrance, the unit represented a standard measurement of time and credit for each academic subject. The major consequence of this unit was that it led to the organization of departments in high schools. Eventually, the Carnegie unit became an accreditation requirement, meaning that the graduates of high schools that adopted this system could be admitted to universities without entrance examinations.

What this detailed analysis reveals is that the school, as we currently know it, is a historical product of decisions made by certain individuals and groups in the past. As the authors note, both innovations emerged in response to the pressing need for standardization. This explains why the two innovations were taken up without resistance, shaping education in its present form. On the other hand, while the educational system eagerly adopted these two innovations for standardization purposes, it proved difficult or even impossible for subsequent innovations to change it. Once the grammar of schooling had been institutionalized, it turned out to be very resistant to change.

The second source is the work of Cuban and colleagues (Cuban 1986, 2001, 2013; Cuban et al. 2001). Cuban's contribution is the historical examination of ICT-related educational reform and educational reform in general. Cuban also addressed the problem of reform failure and attempted to analyze it historically in structural terms. Cuban (2013) distinguishes between incremental and fundamental

change. He defines *incremental* (or first-order) changes as amendments to current structures. As he explains, these changes are superficial ones, functioning as add-ons to current practices without changing them. Examples of incremental changes include new academic subjects, new reading or mathematics programs, changes in class size, and extending the school year. What characterizes incremental changes is that they do not change the core of schooling. On the other hand, *fundamental* change involves changes in the very building blocks of schooling. Fundamental (or second-order) changes constitute foundational shifts to the core of schooling. Examples of fundamental shifts are funding (vouchers, charter schools), governance (site-based management, mayoral control), organization (age-graded school), curriculum (hands-on science), and instruction (teacher-centered, student-centered).

As Cuban (2013) notes, most of the innovations that are implemented end up being incremental rather than fundamental. Consequently, while incremental changes occur frequently, fundamental changes occur less often. Despite frequent attempts by administrators, policy makers, and other stakeholders to change teaching practices, schools have endured. This phenomenon is what Cuban (2013) characterized as "change without reform." According to Cuban (2013), to understand this phenomenon, one will have to take a closer look at what he calls the "black box" of classroom practice which is inaccessible to parents, administrators, policy makers, and all other stakeholders.

Cuban's account is interesting as the focus is not solely on the individual teacher; rather, it is on the institutional and other factors influencing teacher work. He underscores the main fallacy underlying reform policies that typically focus on teachers and their characteristics rather than the situations in which teachers find themselves. As he notes, teachers have no control over the cultural capital that students bring to school. Cuban provides detailed accounts of several reforms, some of which are directly related to ICT. In every reform case analyzed, failure is never attributed to individual teachers and their characteristics. Instead, Cuban (2013) illustrates how factors beyond the control of teachers eventually get to influence their practices. For example, he describes how certain reforms (e.g., technology, science curricula) failed to change practices while others (e.g., testing-driven accountability) had a profound impact on classroom practices. Cuban (2013) points out that the pressures exerted on teachers often have the opposite effect from what reformers aspire to achieve: teachers domesticate an innovation to adapt it to current practices, at times even going so far as distorting and denaturing it. As he argues, educators create "hybrid practices," assimilating reforms into current practices rather than change current practices to actualize reform.

What are the main insights that can be derived from the historical conceptualization approach? The main contributions of the two historical sources briefly introduced, the grammar of schooling and incremental-fundamental change scheme, involve an emphasis on the historical change of organizational structures. In the following section, we explore the main implications of the historical approach and turn to the literature (both general and ICT reform specific) for examples suggesting that a different unit of analysis is required.

7.7 Implications of the Historical Approach: Understanding Evolution in Context

The main assumption underlying the pragmatic conceptualization is that changing teacher views is sufficient for changing teacher practices. The historical approach calls for attention to context. However, once attention shifts from individual teachers to the broader context, the limitations of the pragmatic conceptualization become evident. In terms of reform, the importance of contexts has been stressed. For instance, Kennedy (2010) argued that we need to move beyond the focus on the individual teacher and examine the teaching situation itself: school, classroom, schedule, and resources. Trumbull (1999) also illustrated that it is essentially the material conditions of practice in which teachers operate that eventually shape what they are able to actualize reform-wise.

Turning to ICT reform, contexts have also been found to play a critical role. The role contextual factors play in terms of ICT use has been well documented in the literature (Olson 2000; Zhao et al. 2002; Liu 2011). Somekh (2007) argued that many factors should be taken into consideration when examining an ICT-based innovation. Granger et al. (2002) also stressed that, in order to understand how teachers relate to technology, a complex set of connections between individuals, technology, and the social, political, and material environments will have to be taken into account. The uptake of ICT has been influenced by a host of contextual factors such as school areas and subject matter (Ward and Parr 2010), working contexts (Hennessy et al. 2005), as well as school policies and context (Starkey 2010). Van Braak et al. (2004) found that only 21% of the class computer use variance was accounted for by the independent variables used in the study. The authors stressed the need to go beyond individual teachers and consider organizational factors such as time constraints, available resources, support, teamwork, and training. Interestingly, in a subsequent study (Hermans et al. 2008) where they explicitly addressed school-level factors, they found that 18% of the class use of computers could be accounted for by school-level variables. Finally, in a multiple case study Karasavvidis and Kollias (2014) examined technology integration with three highly qualified teachers. The main study finding was that the dominant local science education paradigm and the "grammar" of Greek schooling constrained rather than facilitated technology integration.

Given the importance of contexts for understanding technology integration, it is interesting to see the picture that emerges should we look at contexts. The evidence suggests that teachers value and prioritize different things compared to what researchers, policy makers, and educational authority leaders would expect. More specifically, Baek et al. (2008) inquired into reasons why teachers use technology. The reasons teachers gave included the following: external requests and expectations of others, increasing student attention, using the basic functions of technology, relieving physical fatigue, class preparation and management, and using enhanced technology functions. As the findings suggest, teachers' conceptualizations of technology are not aligned with the corresponding ones held by policy makers or researchers. As corroborated by several studies, this

finding has been consistent. Cox et al. (1999) surveyed 82 teachers on the reasons that influence ICT use in their classrooms. The findings show what teachers considered important: make the lessons more interesting, easier, more fun (for both them and their students), more diverse, more motivating for the students, and more enjoyable. According to the British Educational Communications and Technology Agency (2006) report, the criteria used by teachers to select software included the following: fit with curriculum and schemes of work, value for money, ease of use, suitable for all abilities, engaging for students, having a clear educational purpose, and adding value to other teaching. Liu (2011) also reports that the major motivational force behind technology use in classrooms is external forces such as principals, colleagues, and governments. Teachers feel pressure to integrate technology into their practices by principals, municipal authorities, and curriculum (Wikan and Molster 2011). In fact, the researchers found that most teachers use ICT for reasons of peripheral support to learning, such as access to learning materials, increasing student motivation, and improved presentations.

Overall, the aforementioned evidence confirms Kerr's (1991) initial observation that teachers' responses to the question "What determines technology use?" will probably startle academics and administrators alike, but they will hardly surprise any teachers. Therefore, what emerges is that teachers have a different set of priorities compared to administrators and policy makers. Understanding such priorities is essential as it shows what the teachers perceive of as important and why. What teachers perceive of as important is influenced by the pressures that they experience. These pressures define the material conditions in which teachers function, work, think, and practice. It is also these material conditions that eventually shape their views of the value of technology and of whether it fits into their practices or not.

The main contribution of the historical perspective is that it helps us represent the problem of ICT integration not as a singular one, namely, entirely dependent upon teacher views and choices, but rather as a problem that needs to be studied in context. This view neither negates nor denies teacher agency. However, it stresses the need to examine the scope of this agency, as teachers (a) have only certain degrees of freedom and (b) cannot operate independently of the contexts in which they find themselves. Consequently, as opposed to focusing only on changing teachers' views about technology, we will need to broaden our analytic focus to take contextual factors into consideration. While the historical approach succeeds in bringing contextual issues to the fore, it lacks the conceptual toolbox that may facilitate a more systemic analysis of contexts. Moreover, while contradictions are often described in the historical conceptualization (e.g., Cuban 2013), it lacks the concepts to theorize such tensions and contradictions.

In the next section, we will turn to a theoretical framework which provides us with the conceptual tools to (a) explicitly examine practices in systemic terms and (b) understand why and how tensions arise from the implementation of reform. As we will argue, the historical perspective can be greatly complimented by an activity-theoretical perspective.

7.8 Activity Theory Conceptualization

Activity theory (hereafter AT) has its roots in (a) German philosophy, particularly in the works of Marx and Engels and (b) in Soviet psychology. AT is situated in the intellectual tradition of cultural-historical psychology, developed by Vygotsky and his colleagues, Leont'ev and Luria, in the early twentieth century. Vygotsky's seminal work (Vygotsky 1960/1981, 1978, 1987; Vygotsky and Luria 1994) provided the general foundations for studying human consciousness. Vygotsky's focus was on how material and nonmaterial tools such as signs mediated human mental functioning. He examined how material and specifically nonmaterial tools such as signs and symbols mediate human mental functioning. As represented by the well-known triangle (see Fig. 7.1), a subject does not act on an object directly: material and nonmaterial tools mediate the subject's relationship to an object. Vygotsky's principal contribution was the broadening of the unit of analysis, which involved taking into consideration mediational means as well as social others. This mediational scheme represented the first generation of AT (Engeström 2014).

Leont'ev shared the same starting points with Vygotsky. However, unlike Vygotsky, who focused mostly on symbols and signs, Leont'ev's approach to consciousness was a more materialist one. In his approach, activity is used as the main explanatory principle (Leont'ev 1978, 1981a, b). Leont'ev's conception of the activity involved the distinction of activity, action, and operation which correspond to motive, goal, and conditions, respectively. An activity is always object-oriented in the sense that it tries to meet a specific need which represents the motive behind the activity. Depending on the complexity and the circumstances, an activity is comprised of actions, the completion of which satisfies the original need. These actions are always realized in certain contexts; therefore, the existing conditions determine which specific operations will be implemented to materialize each action. Leont'ev's contribution, i.e., the differentiation between individual action and collective activity, constitutes the second generation of AT (Engeström 2014).

Engeström has further developed Leont'ev's AT (Engeström 1999, 2014), and cultural-historical activity theory (CHAT) has been advanced as a framework that encompasses the approaches of both Vygotsky and Leont'ev (Cole 1996; Cole and Engeström 1993). Engeström enriched Leont'ev's original triangle linking of a subject and object through a mediational tool with other components such as rules, community, and division of labor (Fig. 7.2). This new version of AT, which represents the third generation of AT, takes as its unit of analysis the "object-

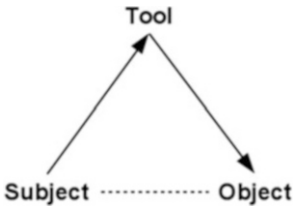

Fig. 7.1 The tool-mediated structure of human activity

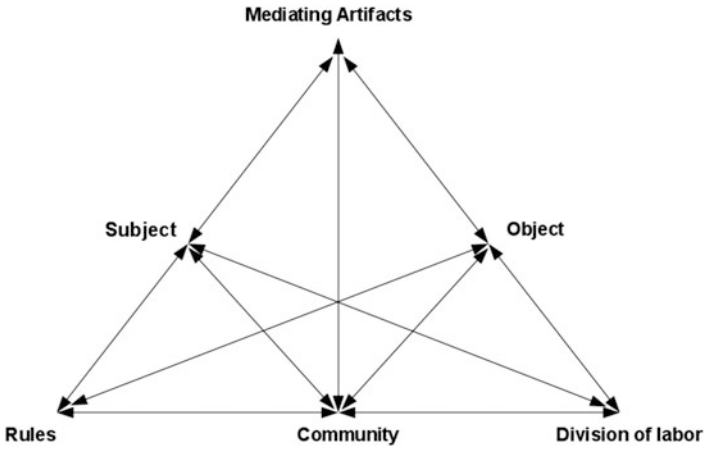

Fig. 7.2 Depiction of the main components of an activity system

oriented, collective and culturally mediated activity" (Engeström and Miettinen 1999, p. 9).

In its expanded from, AT is a theoretical framework ideally suited for the holistic study of human activity. Its value stems from its potential to represent the main constituents of human activity, overcoming the limitations of using the individual as the unit of analysis. The focus on object-oriented activity, which is pursued collectively, is a critical advancement as it addresses the distorted image of a solo individual. The second advantage of Engeström's conceptualization is the fact that such a comprehensive mapping of human activity enables the researcher to determine inconsistencies, friction, and conflict within the components of an activity as much as between components. In the course of two decades of work, a large set of published studies have applied the AT framework both in other areas and in education (e.g., Engeström et al. 2002; Russell and Schneiderheinze 2005; Sannino and Nocon 2008; Yamazumi 2008; Sannino 2008; Nocon 2008; Rasmussen and Ludvigsen 2009). For our purposes in this chapter, AT is a particularly useful theoretical framework for the study of educational reform in general and ICT-based innovation in particular. In the following section, we will explore the main implications of AT for reform by drawing on the available literature. It should be noted that, as a rule, the findings presented in the next subsection are from studies that employ theoretical frameworks other than AT.

7.9 Implications: ICT Reform Seen Through the Lens of Activity Theory

An activity system has a specific object. The whole activity system is configured to facilitate the pursuit of this object. A reform can be seen as a change that is introduced into a system, usually ending up disturbing it. Typically, the

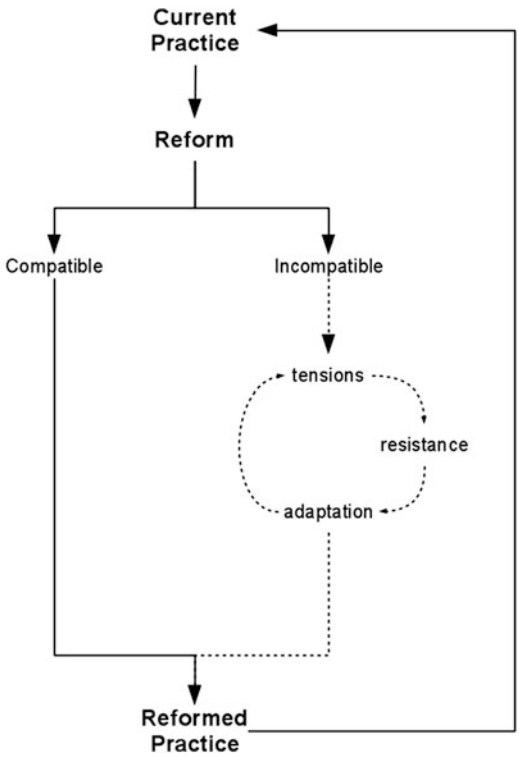

Fig. 7.3 A typical reform cycle

introduction of a reform will either introduce a new object of activity or modify existing components of the activity system. When the new meets the old, tensions arise in the form of conflict, and resistance to reform is likely. AT enables researchers to map out points of friction and determine what impedes innovation in a systemic manner. Depending on the context and the objectives of reformers, reform can take many *forms*: curriculum, resources (a special case of which is technology), exams-testing-evaluation, class size, time allotted, curricular organization, and instructional strategies. A generic life cycle of reforms is depicted in Fig. 7.3.

Incompatibility and disruption in the unlikely case that the reform is fully *compatible* with current practices, then it is adopted without further problems. This is the best-case scenario in which teachers adopt an innovation without complaints, concerns, or resistance. In this favorable scenario, the reform does not introduce tensions within or between the components of the activity system. In fact, if the reform helps pursue the existing activity object more effectively or efficiently, then it will not only be acceptable but even welcome. Innovation diffusion research has consistently confirmed compatibility to be one of the four main characteristics of innovations that influence adoption rates (Rogers 2003). Compatibility of the innovation in terms of values, past experiences, and needs is a critical adoption factor. Moreover, the aforementioned historical approaches have

also convincingly documented how the nature and the timing of certain reforms (such as the Carnegie unit) were easily taken up as existing practices were in need of standardization (Tyack and Tobin 1994). There have been quite a few notable examples of technologies that teachers have welcomed, such as the overhead projector (Cuban 1986) and more recently the video projector, presentation software, and currently interactive whiteboards (Beastall 2006; British Educational Communications and Technology Agency 2006; Cuban 2013).

However, if the reform is *incompatible* with current practices, tensions are unavoidable. We take a closer look at tensions in the next subsection.

7.10 Tensions

Generally speaking, tensions appear as any form of friction resulting from reform. Essentially, tensions are manifested in many guises such as difficulties, troubles, problems, friction, disturbance, conflict, and, generally speaking, as any negative sentiments associated with reform. In terms of AT, tensions indicate contradictions, either within or between the components of the activity system.

There are several examples of tensions in the literature, both concerning reform in general and ICT-specific reform. Regarding the former, Cuban (2013) details the introduction of new science curricula in the USA in the 1960s. As he argues, reformers changed the official curriculum (first layer), but this change had little influence on the taught curriculum (second layer). Neither did this reform influence what students learned from the taught curriculum (third layer) nor on the curriculum that was eventually tested (fourth layer). Essentially, the problem stemmed from the dichotomy of teaching about science vs. learning to do science. Interestingly enough, Cuban (2013) does mention gaps, discrepancies, and contradictions within and between these layers without adopting AT. Consequently, it is particular in such cases where AT can be most useful. In AT terms, there was a contradiction within the object of activity, as the reform introduced a new, markedly different object for science learning.

In her multiple case studies, Trumbull (1999) documented the problems that new teachers experienced as they entered the profession in their attempts to implement constructivist approaches to science. She reported several tensions that the new teachers experienced: (a) *teaching* (lecturing and expository teaching vs. project work), (b) *biology teaching* (memorization of facts vs. going beyond the facts and understanding the mechanisms), (c) *lab instruction* (cookbook-recipe labs vs. open-ended design labs), (d) c*urriculum* (specialized vocabulary vs. concepts), and (e) *curricular guidelines* (no curriculum guidelines vs. mandatory state exam with according curriculum). Much like Cuban (2013), Trumbull (1999) only mentions such contradictions without further theorizing them. In terms of AT, any diversion from the corresponding established approaches created tensions between existing (i.e., vocabulary memorization) and new objects of activity (i.e., conceptual understanding) as well as tensions between old (lecturing; cookbook-recipe labs) and new resources (project work; open-ended labs).

Turning to *ICT-specific* examples, one of the teachers in Windschilt and Sahl's (2002) study wondered: "How will this (i.e., Laptop) go into math?" (p. 183). This remark suggests that this teacher did not perceive technology as a resource to help with mathematics learning; that is, he did not see technology as a solution. Rather, he saw it as an add-on that he will have to figure out how to integrate in mathematics. That is, he viewed technology as an additional problem that he would have to resolve. Again, AT is helpful as it shows how the teacher experienced a conflict between a newly introduced mediational artifact (computer technology) and the object of activity (learning mathematics).

While the teachers in the Hennessy et al.'s (2005) study expressed commitment to ICT integration, they also expressed concerns centered on three major tensions. First, they complained about wasting time on ICT skills, thereby decreasing the amount of time spent on subject-specific concepts. Second, teacher concerns also revealed tensions between using ICT and conforming to the external pressures of traditional examinations. This is a major concern also highlighted in other studies (Li 2007; Chen 2008). Finally, the teachers realized that ICT had transformative effects, making some tasks easier, such that there was no thinking involved. In terms of AT, all three tensions indicate a contradiction between the object of activity (subject learning; exam scores) and the mediational means used (ICT).

In their study of how teachers took up ICT in their practices, Baggott la Velle et al. (2004) reported three major tensions. The first tension involved lab work: instead of capitalizing on the important features of simulations, the teachers viewed them as an impoverished version of practical work, which reflects a contradiction between object and mediational means. The second tension identified was related to the use of the Internet as an information source. The teachers viewed the Internet as a method of bringing currency to curriculum content. When employing the Internet as an information resource, however, the teachers realized that their students lacked the skills to interpret the information they gathered from Internet sources, a tension which reflects a contradiction within the object of activity.

When teachers see the curriculum as overloaded, then they might feel under pressure to cover the curriculum rather than use technology for teaching the curriculum. Baggott la Velle et al. (2004) found that ICT enabled students to take shortcuts, skipping the curriculum altogether. Teachers in the Eteokleous's (2008) study also expressed problems related to the curriculum: they reported that the curricular philosophy was not aligned with the progressive instructional practices which required a high degree of ICT integration. Along the same lines, Penuel et al. (2007) also reported that, if the ICT-based innovation is not aligned with district and state standards, problems might arise. In terms of AT, these examples of incompatibilities indicate tensions experienced by the teachers who either attempted or contemplated to use ICT. An example of such tensions is provided in Karasavvidis (2009) who examined primary teachers' views about the conditions under which Computer Supported Collaborative Learning (CSCL) could be integrated into their daily practices. The teachers mentioned lack of instructional time and curricular pressures as the main obstacles to such an adoption. Using AT as a theoretical framework, Karasavvidis (2009) detailed three major sources of tension between existing and CSCL practices.

Finally, as alluded to earlier, ICT will also have to be compatible with the dominant examination culture. If it is not, then tensions are highly likely. One of the teachers in Li's (2007) study stressed that what was essential for her was to make sure that her students pass the tests and exams. To this end, she preferred to spoon-feed her students from a book rather than use technology. A similar finding was reported by Chen (2008) who concluded that the primary goal of the school where he conducted his study was to prepare students for examinations. Consequently, the teachers refrained from using technology to conduct creative but time-consuming activities. As they explained, allocating class time for technology use was difficult. Again, seen from the AT perspective, these case of incompatibility suggest conflicts between the object of activity (subject learning as measured by the officially sanctioned test instruments) and the mediational means (ICT) which emerged when teachers attempted to integrate technology into their practices.

7.11 Resistance

When a reform is introduced into an activity system, teachers will necessarily need to respond, one way or another. Quite often, teacher responses take the form of resistance. Resistance may be implicit or explicit, active or passive. Teachers' responses to reforms may fall along the continuum between fully compliant and minimally compliant. This resistance might originate from the subjects of the activity per se (i.e., teachers), from the objects of the activity (i.e., students), or from other community members (e.g., parents or other stakeholders). The major sources of resistance are given in Fig. 7.4. In the remainder of this section, we will present the main sources of resistance to reform and discuss the relevant literature.

7.12 Teacher-Related Resistance

Teacher-related resistance can take one of two major forms, both of which are strongly interrelated. On the one hand, when asked about what impedes the realization of innovation, teachers often complain about *time*. On the other hand, teachers also express concerns about the *effort* involved to materialize reform.

7.13 Time

A typical manifestation of tensions is teachers' complaints about time. When faced with technology reform, more often than not, teachers will complain that they lack the time to implement it. As it has been noted, time acts as a "code word" for other troubles (Olson et al. 1999). In general, the history of reform suggests that the time involved in realizing a change might hinder its uptake (Rogers 2003, pp. 20–23). For instance, the failure of the Dalton Plan implementation in US education in the early 1920s was in part due to teachers' objection to the time involved in realizing it

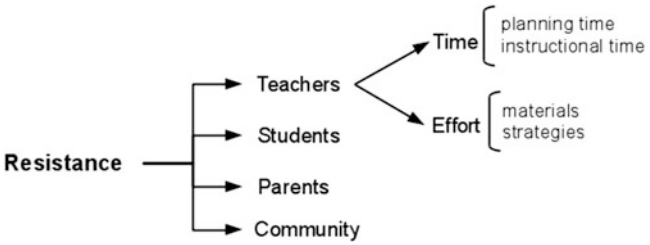

Fig. 7.4 An outline of the sources of resistance to innovation

(Tyack and Tobin 1994). The issue of time appears to be recurrent in ICT reform studies. Soloway et al. (2000) report that time was one of the conditions needed to facilitate ICT integration. Time was an obstacle frequently mentioned by teachers when asked about technology use (Condie et al. 2005). Likewise, Li (2007) reported that teachers believed that technology use demands time. Cuban (2013) concluded that teachers' resistance to technology can be partly explained by the sheer amount of *time* required to change classroom routines. Hayes (2007) also reported that successful integration of ICT by teachers depended on the availability of *time* to reflect on their current practices, to collaborate with their colleagues, and to experiment with new approaches to teaching. Similarly, Sandholtz and Reilly (2004) report that time was the resource most often requested by the teachers who needed time to learn, to prepare, and to experiment.

Generally speaking, the issue of time that teachers mention as a problem can be partitioned into two main categories: (a) *planning time* and (b) *instructional time*. *Planning time* is critical for teachers. Kennedy (2010) points out that the typical ratio of planning time to instructional time is 1:5. As she notes, in reality, this is significantly reduced, as the teachers need to perform several other duties—especially when they are at school. Consequently, teachers often have to resort to spending their own personal time (such as evenings, weekends, and holidays) for planning. Several studies on ICT innovation report planning time as a critical factor for ICT uptake. Lack of planning time has been reported by teachers in the Cuban et al.'s (2001) study. Angers and Machtmes (2005) concluded that teacher planning time was a key factor determining the extent of how technology gets used. In an ICT teacher-training context, Conlon (2004) concluded that time was the most sought after resource. Teachers need time to explore technology and develop their relationship with it (Beastall 2006), as well as to learn new materials and software (Kerr 1991). Often teachers request more time to plan for technology use (Sandholtz and Reilly 2004; Penuel et al. 2007; Windschilt and Sahl 2002). These findings suggest that *time outside class is required* and that teachers might not necessarily have this luxury. Technology seems to pose heavy constraints on preparation compared to other reforms. For example, more than 50% of the teachers surveyed in Voogt's (2008) study reported that the use of ICT had increased the time they needed for lesson preparation.

The amount of *instructional time* teachers have at their disposal for integrating technology is fixed. If technology takes up more time than teachers have available in a single period, then they may be reluctant to use it. Even early survey studies found that teachers devote considerable time and effort to teach with technology in their classrooms (Sheingold and Hadley 1990). Teacher concerns regarding instructional time can take various forms such as distraction (Granger et al. 2002) and waste of time (Hennessy et al. 2005; Chen 2008). These studies suggest that, when teachers are under pressure to cover all content, they are not willing to allocate class time for time-consuming technology activities.

7.14 Effort

Time concerns are often a function of the effort required, so teacher resistance is also expressed in the form of the effort expenditure that will have to be invested. Effort-related issues might refer to concerns about new materials or new teaching strategies. Therefore, time translates to the effort required for preparation (i.e., create materials) and experimentation (i.e., develop strategies, determine what works and not, and develop a teaching method).

Implementing an innovation calls for new *materials*. Searching, developing, gathering, or adapting materials requires a considerable effort by teachers. For instance, to create new materials to support an innovation, teachers might need to reconsider—among others—the curricular content that comes into play, the presentation materials, the tasks that are to be used for teaching the specific content, the homework assignments, and exam materials. As Trumbull (1999) stressed: "...finding new materials that support new teaching practices takes more time. Learning to modify or develop materials takes even more time" (p. 109). Overall, the amount of labor involved for developing and adapting new materials is not something that educators will take lightly. The history of educational innovations suggests that the reasons for failure are often related to the sheer amount of work that teachers have to put into implementing an innovation. Tyack and Tobin (1994) offer three telling examples of reform which failed because the demands made on teachers were far too labor-intensive. Cuban (2013) also attributed teacher resistance to the energy that teachers will have to use to materialize an innovation. Therefore, change throws teachers off their familiar patterns, making high demands in terms of effort.

A similar pattern emerges when one considers studies related to ICT-based reform. The situation is succinctly summarized by a teacher in the Office of Technology Assessment (OTA 1995) report. As the teacher stated, after many years of experience, he had figured everything out. However, if he were to start using technology, he would have to start from scratch, figuring everything out again.

Changing *instructional strategies* also involves considerable effort and might lead to teacher reluctance. Where there is a mandated curriculum that teachers need to cover within a given time frame, teachers tend to resist ICT-based reform

(Eteokleous 2008; Siorenta and Jimoyiannis 2008). This content coverage usually takes the form of time pressure: teachers explain that integrating technology into classroom activities would be very time-consuming (Chen 2008). In the Granger et al.'s (2002) study, time was one of the two most frequent obstacles to ICT implementation. Resistance to ICT was reflected in teacher concerns that time spent using technology was not devoted to the curriculum they had to cover. Implementing novel teaching strategies can be very demanding for teachers in terms of the time required. For instance Norton et al. (2000) report that using technology in mathematics class for learning about quadratic equations required exploratory learning which in turn required time for exploration. However, this time was unavailable because the teacher had to prepare her students for the upcoming tests.

Overall, AT helps conceptualize time-related teacher concerns and similar findings have been reported by AT-inspired studies. More specifically, Nocon (2008) identified time as a source of innovation-related conflicts. A similar picture emerges from Sannino's (2008) analysis which indicates that teachers were pressed for time regardless of their interest in continuing an innovation.

7.15 Resistance from Other Sources

Broadening the focus to include other participants reveals that, in addition to the subjects of the activity system (teachers), both the objects (students) and the broader community (parents and other community members) might have to resist reform. To date, the literature has almost exclusively focused on teachers. Interestingly enough, however, as some studies indicate (e.g., Tyack and Tobin 1994; Cuban 2013; Trumbull 1999), it is not just teachers who might be reluctant about reforms. It is often students, parents, and other stakeholders who might oppose innovation.

With respect to *student resistance*, students have also developed expectations regarding the conduct of lessons, so reforms affect them as well. Tyack and Tobin (1994) discuss two reforms that student resistance helped overturn. In the first case, the Dalton Plan reform, the innovation was largely student-centered, granting students more responsibility and freedom than traditional approaches. Resistance also came from students who complained that solitary and independent work was more boring than typical classwork. In another innovation examined, the High Schools of Tomorrow, Tyack and Tobin (1994) concluded that the innovation did not work well with students who had learned to work in a more directive environment. While some students enjoyed having many choices and free time during the school day, students lacking the basic skills for independent work struggled. A second case of student resistance is vividly illustrated in Trumbull's (1999) study. In their attempts to materialize constructivist science pedagogy, the new science teachers who participated in her study tried out various innovative approaches to teaching such as open-ended homework assignments. As the novel assignments were different from the variety to which the students were conditioned, the students

complained. Because the students lacked the required skill sets (e.g., comprehension strategies), completing open-ended assignments (such as find an article about genetics in a newspaper and write a one-page summary) was very demanding. To date, we are not aware of any studies detailing how students respond to ICT-based innovations. As a rule, student voices are unexplored so the corresponding student perspectives remain undocumented.

Parental resistance is also important as far as innovations are concerned. Tyack and Tobin (1994) discuss two innovations that were subverted with the aid of parents. In the first case (Dalton Plan reform), eventually the parents were among those who expressed discontent with the reform measures, complaining about the decline of motivation and discipline of students. In the second case (High Schools of Tomorrow reform), the flexibility of the reform was not particularly welcomed by parents, as it deviated drastically from what parents deemed to be a "proper" high school (Tyack and Tobin 1994). As a rule, parental voices regarding ICT reform are not documented. In what appears to be a notable exception, Chen (2008) reports that *parents* exert pressure on teachers, which eventually impedes technology use. In fact, Chen (2008) concluded that parental pressure is a substantial obstacle to technology integration. As he put it: "Various types of pressure might compel or even force teachers to resume lecture-based instruction and repetitive practice" (p. 71).

7.16 Adaptation

The last stage in the life cycle of reform is adaptation. A reform might create tensions that might lead to resistance and, eventually, adaptation. When teachers are confronted with an innovation, they only have two alternatives: either support it or subvert it (Hodas 1996). In terms of AT, the subject (teachers) will attempt to ease the tensions that arise from reform. One frequent problem with the adoption of reform is fidelity, as the reform might be reinvented (Rogers 2003). What this means is that the reform that teachers eventually adopt might not be exactly what reformers initially had in mind when they conceived the reform.

Non-ICT-related reform research has indicated that teachers tend to reject approaches that are incongruent with their beliefs or that do not fit with existing instructional practices. For instance, Coburn (2004) examined reading comprehension innovations in a US state over a period of three decades. Teachers interpreted reading-based innovations in terms of their existing practices and fitted innovations in their practices, even though if it meant that the innovations were distorted in order to fit current practices. Tyack and Tobin also discuss (1994) how teachers transform an innovation when applying it in practice, to the extent of subverting it or changing altogether. Cuban (2013) has also provided several similar examples of reforms that teachers adapted to their practices, often denaturing the reform per se.

A similar pattern regarding adaptation emerges in the case of ICT-based reform. As opposed to revolutionizing current practices, ICT has been basically assimilated into them. In summarizing the impact of computers in classrooms over the first

decade of their introduction, Cuban (1993) concluded that the classroom has won, i.e., it has assimilated computer technology rather than computer technology having transformed classroom. Cuban has reached the same conclusion in follow-up studies (2001, 2013). As already discussed in the introductory section, the literature finding that ICTs are mainly used to sustain current classroom practices is consistent (e.g., Hennessy et al. 2005; Donnelly et al. 2011; Player-Koro 2012; Voogt 2008; Yang 2012; Hayes 2007; Hermans et al. 2008).

Summing up, as a framework, AT can be used to interpret the tensions-resistance-adaptation loop depicted in Fig. 7.3. On the one hand, in terms of AT, the established practices which weave the material conditions in which teachers operate can be seen as dominant activities (Sannino 2008). In this regard, an innovation can be seen as a competing, nondominant activity, striving to displace the dominant activity and its object. Additionally, adaptation can take the form of a hybrid activity system (Yamazumi 2008), which results from the interplay between the dominant activity and the innovation that is introduced. Resolving tensions may be considered as a hybrid activity that often emerges as a viable alternative for teachers.

7.17 Discussion: Reconceptualizing the Barriers to ICT Integration

In the first section of this chapter, we reviewed the current status of ICT integration in education. As the research literature suggests, ICT integration is characterized by two main problems: (a) the extent of ICT use is low (Fraillon et al. 2014; Law and Chow 2008; Zhao and Frank 2003), and (b) whenever used, ICT is integrated in ways that sustain rather than transform current practices (British Educational Communications and Technology Agency 2008; Fraillon et al. 2014; Gray et al. 2010; Donnelly et al. 2011; Player-Koro 2012; Voogt 2008). The dominant view regarding ICT reform was then presented. According to this pragmatic conceptualization, two main clusters of barriers to ICT are identified, first-order and second-order ones (Ertmer 1999, 2005). As we pointed out, the pragmatic conceptualization has two important limitations, inappropriate unit of analysis and individual-blame bias. To address these limitations, we turned to two alternative theoretical perspectives on reform.

Firstly, we examined the historical perspective (Cuban 2001, 2013; Tyack and Tobin 1994). Using a historical analysis, this perspective highlights the importance of contextual factors for understanding reform. Important insights can be gained from the study of how reforms evolve in context. We have reviewed the literature to document how contexts are critical for understanding ICT reform. The main contribution of the historical perspective is that it stresses the importance of context and history, extending the unit of analysis from individual teachers to the broader contexts in which teachers work. As we argued, the main implication of the historical approach is that it helps reframe the problem of ICT integration from a singular issue to a contextual one. Despite the insights that can be gained from the

historical perspective, we identified two main limitations: (a) the lack of specification of the unit of analysis and (b) the lack of theory to untangle the notion of tension and show its source, dynamics, and consequences. To address these limitations, we turned to AT which can greatly compliment the historical perspective.

AT enables (a) a systemic approach to practices and (b) an account of the tensions emerging from reform implementation (Engeström 1999, 2014; Cole and Engeström 1993; Engeström and Sannino 2010). Unlike the historical perspective, the AT toolkit offers a more concrete unit of analysis, one that facilitates a systemic examination of contexts. Using an object-oriented activity system as a unit of analysis, AT helps examine reform in systemic terms, namely, as an evolving change that involves various interacting agents (teachers, students, parents, administrators). In this regard, AT helps reframe the ICT integration problem as in systemic rather than singular terms (Engeström 2008). Furthermore, AT allows us to uncover the tensions introduced by reform, to identify the sources of these tensions, to explore how teachers experience these tensions, and to respond to them. The main implication of this framework is the mapping of contradictions and resistance that are related to reform. In this regard, we presented several examples from the literature which illustrate tensions, resistance, and adaptation.

Now that we have introduced the two frameworks and delineated their implications, it is time to revisit the pragmatic conceptualization of the problem of ICT integration. As opposed to viewing the problem of ICT uptake in education as an individual teacher issue, we argue that it needs to be seen in more systemic terms. It is insufficient to focus on teacher views and hope that changing teacher views about ICT will naturally and necessarily lead to integrating ICT in their practices in the desired manner. Thus, we propose yet another type of barriers, *zero-order barriers* (ZOBs). We call them zero-order barriers because they represent obstacles that, though less obvious, are even more fundamental than the first-order barriers. In terms of the current barrier conceptualization (Ertmer 1999, 2005), ZOBs refer to the systemic factors that either remain unaccounted for or are misguidedly categorized as first-order barriers: time and effort required rules and legislation, historical traditions, curricula, and examination cultures. In the pragmatic conceptualization, ZOBs are typically mixed together with factors that just determine the physical, "hard" constraints of ICT integration. It should be noted, however, that ZOBs are different from first-order barriers because they constitute contextual forces that shape second-order barriers in their interplay with first-order ones.

More specifically, a simple change in ideas lacks the institutional power to legitimize change in the corresponding material conditions that define teachers' practices. As we discussed, teachers experience various forms of pressures, which lead them to set specific priorities. More often than not, these priorities are not aligned with the priorities of other stakeholders (administrators, policy makers, academic researchers). Teacher concerns regarding time and effort will have to be addressed. Therefore, in addition to changing teacher views, reformers will need to take other measures to change the material conditions which constitute teacher

practices. That is, reformers need to explicitly deal with zero-order barriers. By introducing ZOBs, we mean to emphasize the importance of the material conditions which shape teacher priorities and corresponding practices: rules and legislation, historical traditions, curricula, and testing cultures. We claim that it is only such changes of ZOBs that can modify the material conditions of practice and provide the requisite degrees of freedom to educators for implementing reform. Adopting Cuban's (2013) metaphor, much like sailors need to pay very close attention to coral reefs, educational reform stakeholders (educational administrators, policy makers, and academics) will also need to take into consideration the material conditions which define teacher practices.

We accept that in some contexts, where the situation is conducive to reform and the overall climate is supportive, changing teacher views about the value of ICT will suffice to achieve the desired level of ICT integration. In such cases where success is entirely dependent on teacher views, there are practically no ZOBs. However, in the majority of contexts, simply changing teacher views will not necessarily lead to the desired ICT uptake. Based on the consistent findings of the long history of educational reform, changing teachers' views about ICT might constitute a necessary but not a sufficient condition. If reform efforts fail to address the material conditions which characterize teacher worlds, then the fate of reform will be largely predictable (Sarason 1990, 2002). As the literature shows, teachers will either comply minimally, domesticating the innovation, or strongly resist, denaturing the innovation. Thus, we argue that changing the material conditions of practice, i.e., resolving ZOBs, needs to become a top priority for reformers.

Ertmer's (1999) distinction between ICT integration barriers that are related to teachers and barriers that are not related to teachers puts teachers into the spotlight, ostensibly stressing their agency. As we pointed out, however, this potentially leads to their victimization because they will take the blame for any ICT integration failures, as the experience with previous reforms indicates (Sarason 2002). On the surface, ZOBs appear to downplay teacher agency as factors unrelated to teachers (e.g., rules and legislation, curricula) are considered to be of primary importance. However, we argue that the concept of ZOBs advanced in this work essentially addresses the core of teacher agency. For example, some highly motivated and committed teachers can be remarkably innovative even in the most rigid and unsupportive environments, managing to overcome all sorts of obstacles. These teachers approach contexts actively and end up redefining them—even if it means paying a high price in terms of time and effort expenditure. The problem is that these teachers are only a small minority. As Cuban (2013) points out, being a teacher in a US charter school today practically amounts to nothing short of being a "superhero." He concludes that the expectation that schools are staffed by superheroes is unrealistic. After all, superheroes do not come in large numbers. Ironically enough, it only makes sense to talk about a "superhuman" only when the demands posed by the task far exceed human capabilities. Thus, ensuring that the task demands of teaching practices remain within the grasp of humans practically ensures that rank and file teachers will implement it successfully.

7.18 Limitations

We see two main limitations of our work. First, the concept of zero-order barriers is not supported with our own empirical data. It should be noted that, initially, the concept of ZOBs originated from the analysis of data in one of our former studies (Karasavvidis and Kollias 2014). However, for the purposes of introducing our argument, we deemed it more appropriate to draw on the large pool of empirical studies. We see the converging evidence from various studies as especially promising for our ZOB conceptualization. Our future plans involve the analysis our own data for a more fine-grained account of ZOBs.

Second, to advance our argument we have been very selective drawing on two frameworks, Historical and AT. On the one hand, we have chosen to use only certain concepts from these frameworks, freely combining the two as we saw fit. On the other hand, in our attempt to piece the puzzle of ZOBs together, we have chosen not to be critical of these frameworks. Thus, we have deliberately decided to use them as complimentary, conveniently ignoring their inner limitations (e.g., Rasmussen and Ludvigsen 2009) or even the possibility of their theoretical incompatibilities. Again, our goal in this work was to formulate a first version of our argument rather than examine each framework.

7.19 Conclusion

The failure of educational reform has puzzled educational researchers, administrators, and policy makers for a long time. The same holds for ICT-based reform. The pragmatic conceptualization of ICT integration introduced a practical distinction of barriers in first- and second-order ones. In an attempt to address the limitations arising from the pragmatic conceptualization, we introduced two theoretical frameworks, historical and activity theory, and explored their implications for the problem of ICT integration. To explain the problem, we introduced the construct of zero-order barriers (ZOB). We argued that ZOBs facilitate the understanding of ICT reform as they help uncover what transpires in practice. As we suggested, once teacher voices are taken into account, their views and priorities emerge, revealing the material realities that define their practices. Unless reformers take measures to explicitly address these realities, thereby changing the material conditions which shape teacher practices, the failure of educational reforms is predictable (Sarason 1990).

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Human Capital and Innovations in Education

8

Alexander M. Sidorkin

Does public investment in educational innovations makes sense? Is there a tangible return on investment in innovations, either public or private? We know for certain that investments in expanding the existing modes of education do pay off (Becker 2009). But does it make sense to invest in innovation? This chapter will consider available evidence on impact of educational innovation, primarily at K-12 level. It will also demonstrate the need to conceptualize the impact of innovation. Work conducted within the next generation of educational reform should look very different from what we have done so far.

8.1 The Apparent Failure to Change

Do innovations in education work? The answer depends on what one means by "working." Let us consider the most obvious meaning: the impact of innovations on measurable learning outcomes, on how much, how well, and how fast students are able to learn. In higher education, we have very limited objective measures of academic learning, which is why I will concentrate on the K-12 level. In most developed countries, national systems of standardized testing provide sufficient data on learning outcomes at secondary level. Besides, we can use the international comparative studies such as PISA. Let us consider some of the most visible and most discussed directions of innovation in K-12 education.

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The elusive benefit of information technology adoption is but the latest example of unfulfilled promises of educational innovation. Studies of various technologies' efficacy are not only exceedingly rare; there are few incentives to conduct any at all (Blumenstyk 2016). Neither manufacturers of educational technology nor their institutional customers are eager to find out that one or another expensive thing may not make any difference in the end. We simply do not know if one or another technological innovation in education works or does not work to increase efficiency of learning, and no one seems to want to find out. Large-scale public and private expenditures on hardware and software are fueled almost exclusively by unproven assumptions. Besides the lack of incentives, there is the inherent difficulty of conducting a true causal design study in education. One thing we know for sure: no one can detect any correlation between when and how fast a country has introduced computers and Internet into classrooms and changes in its educational achievement as measured by international comparative studies. In other words, if there was a large impact, we would have seen it at least in some countries. Andreas Schleicher (2015) stated, more or less, just that, using extensive data sets compiled by the Organization for Economic Development and Cooperation (OECD). Karasavvidis and Kollias in this volume present a very compelling and sophisticated analysis of the possible reasons for the information technology's failure to impact outcomes, highlighting differences in the practice of teaching and learning. I find their argumentation very convincing, but for now, it is enough to establish the fact of failure, without considering its causes.

Another relatively recent innovation is the introduction of consumer choice and provider competition into elementary and secondary education. The idea is attributed to Milton Friedman (Friedman and Friedman 1990) and is dated back to a 1950s–era proposal for school vouchers. The idea is not new, and in the Netherlands, for example, it has been practiced since about 1917 (Ritzen et al. 1997). However, in the USA, it was first piloted in late 1990s and then widely introduced in a somewhat more constrained version of school choice under the name of charter schools. Similar institutions exist in the UK as "free schools" and in other countries under various names. This was not a technological but rather an economic innovation, with all the promises of a great, well-founded idea. After all, stimulating competition has been shown to incentivize productivity growth in many other industries. The hope was that schools competing for students will become more innovative and, ultimately, more efficient and effective. Evidence from the large-scale Chilean experiment (Carnoy and McEwan 2003) seems to suggest that it did not happen. There is little evidence that other forms of school choice have shown significantly higher levels of effectiveness and/or efficiency. A meta-analysis of 195 meta-analytical studies of charter school effectiveness has shown a mean effect size of only $d = 0.07$ (Hattie et al. 2015)—a meager result by all accounts. It is a positive result, but not nearly as sizable effect as Milton and his followers, no doubt, had in mind.

Finally, the most visible example of a managerial innovation, the test-based accountability reform, is remarkably little studied. The lack of research is surprising when one considers the scale of the investment in this particular kind of reforms. The research we do have seems to show mixed results. For example, a recent paper (Deming et al. 2016) demonstrated that designating a Texas school

"low performing" created enough pressure to increase graduation rates and test scores but only modestly. Disappointingly, the impact of accountability on life outcomes (such as college attainment or salary) seems to disappear over time. Moreover, schools tend to game the system by classifying more students as special education eligible, and actually harming their life outcomes, while simultaneously raising the average test scores. Ravitch and Mathis (2010) asses the literature on the question "Does Accountability Work?" as mixed "with some studies showing modest test-score gains and others showing null or negative effects" (p. 15).

I limit myself to these three most prominent and likely most expensive innovations in education: technology, school choice, and accountability. These three are not, however, exceptions. In the most comprehensive up-to-date meta-analysis of meta-analyses, John Hattie (2009) establishes the average impact of educational innovations on academic outcomes at 0.4 standard deviations (Hattie 2009, p. 12). Measured by impact on student test scores, educational innovations are, at best, not significantly impactful. This is a sobering realization, and we should try to understand why.

The evidence may compel policy makers to question the wisdom of continuous funding of educational reforms and innovations. Why should taxpayers and private philanthropists keep pouring money into reforming educational institutions that quite visibly refuse to change? The worry might be premature, for there is no evidence yet that policy makers' and philanthropists' appetite for education reform and innovation is wearing thin. Sooner or later, however, the public will be disappointed with the repeated cycle of promise and failure. That is unless we can provide another compelling rationale for continuing to invest in innovations.

8.2 Labor in Education

Let us consider educational innovation in terms of labor economics, according to which both students and teachers are considered to be laborers. This is a departure from Gary Becker's (2009) version of the human capital theory. He states:

> Instead of assuming that time can be allocated only between market labor force activity and nonmarket consumption activity, I now introduce a third category, investment in human capital [. . .] Each person produces his own human capital by using some of his time and goods to attend "school," receive on-the-job training, etc. (p. 63)

For Becker, student efforts to learn are neither labor nor leisure but something else. I won't delve into the reasons why I find this new categorization unconvincing (see Sidorkin 2007). For the sake of argument, let us assume that the school-related efforts to learn are a kind of labor. It may be unwaged labor for students, but then there are other kinds of unpaid labor (volunteerism, military service, domestic work of women, etc.), and the lack of wages does not prevent us from considering them to be labor.

The productivity of student and teacher labor has not changed much over the last century; at least no one can provide evidence of such a change. The Baumol's "cost disease" continues to reign supreme in education as it does in the performing arts. The phenomenon Baumol and Bowen (1966) described suggests that while productivity of labor in some industries does not change, salaries do increase to compete for labor with other industries. Performing arts have experienced many innovations in lighting and sound technologies, stage design, and the way they advertise and sell tickets. Yet the fundamental economics of theater—live human performance—has not become any more productive than it was in Shakespeare's times. The innovations tend to occur at the economic margins of stage theater, and in fact, they tend to make production even more expensive. Technical innovations enhance viewer experience but do not reduce labor expenditures by play wrights, directors, musicians, and actors.

Similarly, education has seen many innovations at its margins, including the ways of seeking, presenting, and distributing knowledge. However, similarly, the rising cost of education has not budged. We have not been able to either reduce the labor expenditures or make student and teacher labor more productive. Just like in stage theater, non-automated and non-scalable labor is at the core of our business.

With regard to student labor of learning, we may be pushing against a simple intrinsic limit on productivity growth: Student effort is directly proportionate to learning outcomes. Neither automation nor division of labor—the two usual engines of productivity gains—is relevant here. In other words, learning has to stay inefficient; otherwise it will not be effective. Automating or otherwise alleviating student labor would be as pointless as making body builder' dumbbells lighter to facilitate exercise. Many educational utopianists have held that learning could be made pleasurable, but they have been saying it for hundreds of years, and yet learning still requires an effort (see, for instance, Flunger et al. 2015; Matsuoka et al. 2015). The obvious fact that some learning could be made fun and joyful does not necessitate that all learning could be made that way. In general, the simple logical fallacy of implied scalability of successful exceptions is amazingly persistent among educationalist thinkers.

The division of labor in learning has similar limitations that are not difficult to imagine: the learning outcomes must belong to one person, and not to a team. There are many ways in which people can learn in group projects, with situational division of labor. But any teacher knows that once the different roles become persistent, it diminishes the quality of education. One of the group members always organizes, the second always presents, the third always does the math, and the fourth always makes it all look pretty. And that is all they learn; their learning becomes limited, too narrow for the purposes of general education. What is normal in the adult world of productive labor cannot become the norm in the world of education. Unless we work in exactly the same groups as we go to school, the division of labor among different members of a learning group can only be seen as a tool of limited utility.

The story of teacher labor as opposed to student labor is different and more complicated, although I will show, and also limited in the prospects of radical improvement. One way to tell it is through a thought experiment. We can be certain

that technological advances will eventually compensate for the weaknesses of teacher's memory, which remains one of the main hindrances in productivity of teaching. Teachers at all levels simply fail to remember the strengths and weaknesses of each of their students, which material and to what degree they have mastered it and what else needs to be done. The advances in learning analytics, in adaptive learning, and in artificial intelligence are now concrete enough to imagine a future *Ultimate Tutor*, a machine that would be endlessly patient with and infinitely attuned to each student's learning path. The Ultimate Tutor is capable of providing each student with an individualized stream of tasks, explanations, videos, and other learning experiences. The machine would assess every action a student makes, every problem she or he solves, and every essay or email the student writes and use the feedback to further fine-tune his or her experience. The Ultimate Tutor could eliminate an unknown quantity of student's life wasted on listening to what is too difficult to comprehend or too easy to pay attention to and on completing exercises and problems that are too hard or too easy. Delivery of the right kind of educational content "just in time" could make a difference.

And yet, what we know about education undermines the utopia. The reasons for the slow spread of innovations in education are not limited to the special characteristics of student and teacher labor. A more profound feature of education is that it deals with work motivation. The Ultimate Tutor can make learning more efficient and one may say more intensive, but it won't compel anyone to learn. In fact, the opposite is likely to happen: If you are a student working one on one with the Ultimate Tutor, your wasted time (read: rest time) is reduced, and you have to apply significant effort all the time. The machine knows exactly what you can and cannot do and what the appropriate level of effort for your stretch zone (*zone of proximal development*) is. You may want to just turn the damned thing off. This may strike one as paradoxical but only at first: students and teachers resist real innovations in education because most make their labor more, not less intensive. Therefore, the resistance may be actually built in, because of human propensity to avoid working today more than yesterday. And please note—the Ultimate Tutor stands in not just for technological innovation but also for any innovation, economic, or managerial, which would increase the efficiency of learning labor.

Learning is a profoundly social activity, not only because of the social dimensions of cognition but also because social groups and institutions generate motivation to work. One may say that schools may undermine rather than generate motivation. Yes in this case some other social relation generated the motive in the first place. The relational canvas of learning is absolutely essential for the vast majority of people. One needs relationships with peers and with teachers to become interested, to apply effort, and to establish self-discipline. That much has been known in theory for a long time, since Vygotsky (1980), and for a long time in practice of teaching and learning. The most recent wave of experimentation with MOOCs has demonstrated the need for relational dimension of learning one more time: only a small minority of people, usually already well educated, can force themselves to learn something alone. For most of the population, lack of learning motivation is an unsurmountable obstacle unless they are placed in a social

situation that encourages learning. If we turn MOOCs into something hundred times smarter, it is unlikely that we will motivate learners. Motivation is a social construct, and we cannot yet foresee any technology that is capable of providing an equivalent of human relations without actual humans at both ends.

One common objection to such an assertion is the example of video games, which without any human interference can motivate a teenager to spend hours on seemingly unnatural activity. Many people believe learning curriculum can be made as addictive as learning moves in video games. I find the logic flawed and have seen no evidence yet to support it. In fact, the gaming industry has made significant efforts to develop the edutainment model, based on the exact assumption. Curriculum as we know it does not fit the intrinsic logic of the game. Playing is clearly entertainment, and learning in the managed, curriculum-limited sense remains mostly in the realm of work. And the motivation to work needs relations.

I am not saying that a relation-replacing or relation-enhancing technology is impossible; it is just that we don't have any prototype or even a theory of relational technology yet. Teaching at its core is relational labor. This much becomes more and more obvious as we are able to unbundle teacher labor and replace some of it with information technologies. When we peel off the thin layers of teacher labor replaceable by machines, what remains is the soft and fragile core of manual relation building, which is both poorly understood and hard to measure. We just now begin to fully appreciate the centrality of the relational dimension of education.

The low impact of educational innovations on student test scores is not an accident; it is such not because we have done it wrong in the past or because educators are somehow especially incompetent or change resistant. No, there is something deeply embedded in the nature of education or in the historically evolved organizational forms thereof. The sort of labor that is at the core of education resists becoming more efficient in the traditional economic sense of the word. The evidence for my claim may look a bit circular, but it does exist: education has been one of the most heavily reformed social spheres over the last half a century, and yet we have very little proof that student or teacher labor productivity has improved.

The point here is not that innovation in education is impossible or undesirable. I am just suggesting that the kind of disruptive innovation that radically improves labor productivity in education is unlikely to happen in the foreseeable future. I am not particularly comfortable with this conclusion and imagine that very few people will be either. I may be a prisoner of the particular framework inspired by labor economics, but a productivity revolution in education seems to be highly unlikely. That is why I find chasing the dreams of techno utopia or managerial utopia equally irresponsible; they both distract us from instigating productive innovations in education. Education reformers cannot continue promising large gains in what economists call the "education production function" (Hanushek 1979) to the public, receive and spend public money, and then fail to deliver and continue to get away with that. The vicious cycle of innovational folly has to stop. One grows increasingly weary of the TED talk style of reasoning—which there is a breakthrough technology out there, just over the horizon and that it will inevitably revolutionize

education. There is nothing wrong with dreaming, but we cannot afford to have unlikely dreams affect public policy.

Instead, we should learn to value and eventually measure what could be called the spillover effect of innovation in education. It could also be called the not-yet-well-measured-but-real effects.

8.3 The Case for Investment in Innovations

In a postindustrial society, innovation becomes the most important driver of development. Therefore, the ability to innovate and the taste for change become important characteristics of human capital. Note that we are not only talking about the production side but also perhaps even more so about the consumption side of contemporary economies. The demand for novelty cannot be taken for granted and should be specifically fostered.

For both the production and the consumption sides of economy, quality of human capital comes to the forefront, because some of the developed nations have reached maximum quantities of human capital. It is not just the years of formal schooling but rather actual skills that become more and more important. The World Economic Forum's Human Capital Report (2016) concludes:

> While current education systems seek to develop cognitive skills, noncognitive skills that relate to an individual's capacity to collaborate, innovate, self-direct and problem-solve are increasingly important. (p. 28)

We do not yet have reliable instruments to measure such qualities objectively, while self-reporting is notoriously unreliable, but it is reasonable to suppose that having an experience of generating or adopting innovation in educational context will have positive impact on a person's further ability to innovate and embrace change. In other words, practicing innovative behavior is likely to produce innovativeness and openness to new experiences, just like practicing any other kind of behavior tends to increase skills needed for such behavior. Schools must produce innovators and innovation adopters.

Empirical evidence presented in this volume by Smirnov, Koroleva, and Khavenson supports the view that innovation at its core is the issue of quality of the innovators themselves, not necessarily of the quality of their ideas. Smirnov has shown that the strongest predictive factors of an innovative process have to do with who makes up the team as innovators and how determined they are to succeed. Khavenson and Koroleva show that innovators are motivated by values of social status and creative fulfilment. Those are unlikely to be fully innate, and are formed, at least in part, through educational settings. This is why, regardless of the traditionally understood effectiveness, turning schools into innovative organizations makes much economic sense.

Moreover, pegging student and teacher labor too closely to measurable learning outcomes may have the opposite effect. Preparing for high-stakes exams may

induce lower risk-taking behavior among both teachers and students and thus inhibit their ability to innovate (Sahlberg 2004). Therefore, the way we were trying to measure the impact of innovation on learning outcomes may be self-defeating, because of this possible confounding variable. The time taken for trying something new reduces time contributing to measurable outcomes.

Consider these findings by Rubera and Kirca (2012) on firm innovativeness and performance outcomes in their meta-analysis study: "the direct impact of innovativeness on firm value is stronger than its impact through market and financial positions" (p. 144). In other words, shareholders reward innovation in excess to its utilitarian value; they reward the innovative effort itself. Moreover, investors support managers of innovative, small firms in low-tech industries even if they show low revenues and profits (p. 144). One may argue that shareholders are mistaken, excessively hopeful, or irrational. However, the authors of the study believe that "innovativeness not only enables a firm to increase its revenues and market share but also leads to the development of internal capabilities" (Rubera and Kirca 2012, p. 144). They conclude:

> Finally, the innovation literature would benefit from taking a broader, multilevel perspective in understanding the effects of innovativeness on firm performance by focusing on broader outcomes than those simply associated with economic valuation (by shareholders, managers, or customers), such as sustainability or general social welfare. (p. 145)

I suggest that public management should adopt a similar attitude toward innovativeness in education. Rewarding innovation as such may not drive up the results of performance tests, but it may strengthen the capacity of the educational system and prevent its fossilization. We do not have a similar data to back up such a claim, because there is nothing like the firm value with respect to educational organizations. However, despite huge differences between schools and firms, one would be hard pressed to identify reasons why innovation would affect organizational cultures of schools in a negative way. One possible exception could be the phenomenon of completely manufactured innovations for the sake of bureaucratic advancement. Such fake innovative activities have been well documented under the pressure of government reforms. However, with genuine innovative practices, the organization culture impact remains very likely.

In a comprehensive review of public sector innovation theory, Gow states, "Everyone wants to have results on innovations measured, but there is not agreement about what should be included in these results, nor about the criteria of success" (Gow 2014, p. 17). Mark Warford in this volume has made a great case for complicating the traditional diffusion of innovation models and for recognizing the complex agency of teachers. Indeed, we cannot describe innovation in education as a simple process consisting of individual decisions: "adopt or ignore." Perhaps we can de-emphasize the diffusion aspect of innovation and consider a non-diffusional model of innovation. The traditional assumption I wish to question is this: it only makes sense when the best new practices spread throughout the industry. This is why

Rogers' model of diffusion is so influential. Indeed, what is the point of an innovation if it is not adopted by others?

In case of education, a reverse assumption is not out of the question. At a very basic level, adopting someone else's innovation prevents one from trying to innovate in exactly the same area. In this sense, innovation adoption competes with innovation generation. If every teacher thinks of herself as an author of innovation, there is little incentive to become an adopter, a follower. It is not clear that encouraging the latter role is better than the former. Paradoxically, in education we may be better off with more innovators and fewer adopters. If the process of innovation is more important than the practical result of it, we may as well incentivize what is more valuable.

In education, we may be better off giving up on the direct impact of innovations on measurable outcomes but instead invest in innovation for the spillover effects. The most important shift I advocate for researchers is to revise the diffusion agenda. What is diffused is not the innovation itself and not new products or models or methods of teaching and learning. Rather, the very process of innovation should be seen as the phenomenon to be diffused.

Hattie (2009) notes, "most of the successful effects come from innovations, and these effects from innovations may not be the same as the effects of teachers in regular classrooms—the mere involvement in asking questions about the effectiveness of any innovation may lead to an inflation of the effects" (p. 6). We cannot yet measure what I would call the universal innovation effect—neither impact on learning outcomes nor impact on propensity to innovate. It is significant to postulate its existence. The very engagement in innovation activities makes teaching more impactful. If more teachers would engage in innovation, the overall impact would increase.

What Rogers (2003) called "relative advantage" cannot be understood narrowly as a boost in the test scores. Rather, the relative advantage is in infusing the sense of newness in the teaching and learning process. It is, if you will, a way of increasing the entertainment value of learning without compromising the measurable outcomes. In other words, innovation makes both teaching and learning more fun, and fun has great economic value.

Recall the relational nature of teaching and learning. Some educational relations are direct, but most are mediated by an activity. To build enduring relations, people need each other for some purpose. In schools, such purposes are hard to find (see more detailed argument in Sidorkin 2002, Chap. 8). However, engagement in a common innovative practice can be such a purpose. To learn something is an individualistic aim. To try to figure out a new way to learn is a collective project, a vehicle for strengthening the relational underpinnings of teaching and learning.

In Rogers' footsteps, characteristics of innovators have been studied for a long time and have continued (see, for example, the chapter by Koroleva and Khavenson in this volume). We have little understanding of how the ability and propensity to innovate can be fostered in an educational setting. Chell and Athayde's study (Chell and Athayde 2009) identifies precursor skills: creativity (imagination, connecting ideas, tackling and solving problems, curiosity), self-efficacy (self-belief, self-

assurance, self-awareness, feelings of empowerment, social confidence), energy (drive, enthusiasm, motivation, hard work, persistence, and commitment), risk propensity (a combination of risk tolerance and the ability to take calculated risks), and leadership (vision and the ability to mobilize commitment). The study shows that particular features of curriculum extracurricular activities, teaching style, and other components of school life can foster innovation skills. The authors created a self-report tool, which is better than nothing, but is still very far from a dependable performance instrument. Working on such an instrument remains the highest priority for the study of innovation in education.

8.4 The New Generation of Education Reform

If the emphasis shifts from the direct effect of innovation to the process of engaging students, our understanding of educational reform must also change. Education policy makers must embrace the next generation of educational reforms aimed at creating a climate conducive to emergence of authentic local innovations that may or may not spread. They may not be effective in terms of measurable learning outcomes (just as the old reforms are), but they will be effective as means of preparing students for the life of innovation and change.

It is difficult to imagine that the new generation of reform aimed at creating innovative ecosystems in education would be more expensive than the accountability, school choice, or technology reforms. Moreover, we do not necessarily have to abandon the three big changes; we just need to modify them. For example, instead of buying big technology systems, we need to make purchases of smaller, more agile apps and systems easier so that more and more educators would be able to tweak their practices. We need to expand accountability by learning to measure the ability to innovate and tolerance to change, among other skills. We should probably tolerate a little more school choice while still trying to control for the tendency to separate students by class and race. We must recognize innovative learning environments as the main and independent aim of the next generation of education reform. More specifically, I recommend the following:

1. Top-down reform as a change strategy has shown very little efficacy and may actually counteract the authentic innovations. It should be replaced with the creation of innovative learning environments. Let us de-emphasize the "what works" approach and instead encourage teachers to engage in collective problem solving on their own. We need to limit the role of canned comprehensive programs of improvement that promise immediate solutions. In fact, every solution and every program should be evaluated by its ability to generate the authentic innovation in schools and other educational organizations.
2. Shifting emphasis from innovation by teachers to innovation by students. Just as teachers often feel shut out of the conversation about the merits of innovations, so may students. However, when they are a part of the team that designs, pilots, and evaluates a new way of learning, students will learn something valuable

about innovations in general. They will acquire personal experience as members of an innovation team.

3. Investing specifically in technologies that target the relational, affective side of teaching and learning. In every developed country, there is an ecosystem to support start-ups, and some projects even support specifically start-ups in education. An overwhelming majority of proposals are related to the use of technologies in learning, itself, in knowledge acquisition. Yet the major bottlenecks in education have nothing to do with learning; they are related to learning motivation, and that, ultimately, is a relational phenomenon.

These are not particularly large investments. Most of the suggestions listed above can be achieved with a particular variation of targeted deregulation. For example, placing emphasis on teacher innovation on par with his or her students' test score gains is cheap, but it can boost the pseudo-market of reputational competition. Such a market already exists; the most innovative teachers and schools enjoy the benefits of media exposure, often prizes and other benefits. These kinds of nonmonetary competition structures can be very helpful in instigating the small-scale authentic innovations. We have to be careful formalizing and measuring teacher innovation, because of the negative effects of Campbell's Law (Campbell 1976). Once a certain measure is used with significant consequences, people learn to game the system. For example, if we formally evaluate teachers by the number of innovations produced, they will respond with a flood of fake innovative projects. Strong incentives tend to corrupt the very activity we are trying to improve. Yet weaker, less tangible incentives can nudge the teaching profession into generating more small-scale authentic innovations. As I said before, such innovations are unlikely to diffuse or to have impact on student test scores but are definitely worth encouraging for the presumed impact on students' ability to generate and tolerate innovation.

The major thrusts for innovation we tried in the recent past (technology, school choice, accountability) have not produced expected results, cost much, and cannot continue indefinitely. We need to change course. I am calling for the new generation reforms in education that are aimed at mass production of authentic innovations. In other words, we have to create organizational ecosystems that encourage many specific, local, authentic innovations. By authenticity I mean simply that change of practices is born by the specific, personal circumstances and is motivated by a personal decision of an educator and students to try so something new. We have to get away from both the top-down reform, with emphasis on fidelity of implementation, and from the techno-utopian attempts to disrupt educational practices.

The alternative is to do nothing and to let the educational system to its own devices. That alternative does not look appealing for a number of reasons. One is political: the public in many developed countries have developed an expectation of school reforms. Even Finland that remains on top of PISA charts feels compelled to introduce a school reform, while everyone around the world is trying to emulate it. Another is economic: even though we cannot be sure that innovation in education

definitely improves the quality of human capital, it would be foolish to wait for an iron proof. As in many areas of public policy, evidence-based yields to plausibility-based decisionmaking.

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Conclusion

We have completed our collective investigation of the innovations in education and their impact on quality of human capital. Needless to say, it has raised more questions than we were able to answer. There is not enough quality research directed to understanding the way education at all levels does and does not change. Yet one conclusion seems to be fairly certain: education is not like other industries where innovations are concerned. This concerns how innovations are generated, adopted, and sustained and how they affect the outcomes. Policymakers, politicians, business leaders, and the public should give up the idea of a quick fix in education, often assuming that if something can be done in communications or manufacturing, it can be done in exactly the same way in education. Such an approach simply does not reflect the reality of the educational enterprise.

Looking at the title, the reader may rightly ask: what unites reform, innovation, and human capital in educational contexts? Extracting the logical essence that streams through the chapters, they certainly speak to the dynamic nature of educational change. Spoken through the title, the chapters tell stories of national to international campaigns to improve the quality of education, campaigns that center on the dissemination of new ideas and technologies, and campaigns that inevitably end up mired in the intricacies of social networks of meanings. It is the unique, global aspect of this volume that adds insights into the latter, and we discern in the deep structure of the ideas in play a dialogue between essentialism and sociocultural perspectives.

In this context, the synchronicity of a volume on innovation that implicitly transcends ideological and theoretical divisions finds itself in preparation for publication following the reemergence of a potential cyber version of the Cold War, where (technological) innovations have literally and clearly been weaponized. The only rational response in such a context is to unleash research on innovations. Innovation research must go global if we hope to transcend the deep tribalism the human species never seems to outgrow.

A scattering of studies without any clear epistemological framework leads nowhere. Educational change needs a larger sort of container, a field that has a broad, interdisciplinary reach. Piecing together the various frameworks advanced here, it makes sense to hold onto the *innovation* construct, given that Rogers' legacy

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pervades nearly the entire volume. That said, and Rogers, himself acknowledged this (Rogers and Jain 1968), the field of education is in a unique position to drive research in ways that have already been amply demonstrated here: educational innovations are ultimately subject to the dynamic interplay of social meanings and hegemonies. Rogers' legacy owes a great debt to Russian-Marxist epistemologies of change: Vygotsky's sociocultural theory of mind, social capital, labor theory, and activity theory are important reality checks on the tendency to look at innovators and innovations within an essentialist framework, with its broad, linear strokes.

If one were to propose a cross-disciplinary field we might call Innovation Studies, this volume highlights a combination of social psychology, sociology, communications, economics, and educational research and perhaps as well as tentative forays into the natural sciences through complex adaptive/dynamic systems theory. There are certainly other fields that may contribute, starting with linguistics, given that meaning would appear to be everything when it comes to the question of how innovations are conveyed and frankly *translated*. Translation studies offer some important insights into crossings of meaning systems that echo a lot of the persistent problems raised here. The crossings of such fields, as evidenced here in this volume, offer a laboratory for working out the various constructs and factors of interest.

Having just used the word *laboratory*, we are also conscious of the fact that rigor of empiricism in quantitative studies relies on a rigor of speculation. As is well established in the field of translation, there is likely to be a period of conflict between empirical and speculative approaches in growing a field of Innovation Studies. By speculation, we do not mean flights of fancy or imagination; we mean the sort of logical, systematic argumentation that is closer to philosophy than to metaphysics. Going forward, the constructs we choose are ultimately empty vessels, their numerical representatives through coefficients or means, etc., mere nominalisms, unless we wring out their essence. Consequently, we should not hesitate to look to the humanities for guidance in making sense of innovation and change.

Education is too important to leave to its natural evolution. Yet is it is too exceptional to hammer with borrowed reforms. We need to learn how to stimulate and guide its innovative energy to help economic growth and social development.

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