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Innovation, Motherhood, and Apple Pie

By Grover "Russ" Whitehurst

Innovation is the new buzzword in education. It has ridden in from the world of business where it has risen to levels at which, "some people run screaming the moment they hear it mentioned."[1] The field of education is more nurturing of buzzwords and magical incantations than most. How can we make sure that the current interest in innovation is productive?

> *Full moon & candles,*
> *magic times three*
> *We summon the power*
> *of innovation to be!*

A recent policy paper called for the U.S. Department of Education to provide competitive funding to, "change the game in public education by scaling up successful educational entrepreneurs, seeding transformative educational *innovations*, and building a stronger culture to support these activities throughout the public sector."[2] The Knowledge Alliance, an entity that lobbies for organizations that provide R&D in education, has called for the new administration, "to turn the page on past efforts … unleash America's ingenuity … deliver break-the-mold solutions … and guide a new … *innovation* revolution in teaching and learning."[3] A recent newspaper article on education research concluded that, "the watchwords for the field in the post-Bush era seem headed toward "development" and "*innovation*."[4] Secretary of Education Arne Duncan testified in his confirmation hearing that one of the important issues that the new administration and Congress will need to tackle is, "promoting *innovation* that accelerates student learning." And President Obama, in a recent visit to a charter school in Washington, D.C., said that he had asked Secretary Duncan, "to make sure that he works as hard as he can over the next several years to make sure that … we're rewarding *innovation* the way that it's taking place here".[5]

A long lever to move this agenda forward is the recently passed stimulus bill, the American Recovery and Reinvestment Act of 2009. One section of that legislation authorizes the Secretary of Education to establish a $650 million *Innovation* Fund to expand the work of schools that have made gains in closing achievement gaps.

Defining Innovation

With a lot of talk and considerable money heading in the direction of innovation, it is worth considering what the term means.   A generic definition is that innovation is the introduction of something new that is intended to be useful. Under that broad umbrella, dozens if not hundreds of distinctions and elaborations have been

expressed. Two critical distinctions are between process and product innovation and between effective and ineffective innovation. These are best represented as dimensions rather than categories.

Effective   <--------------------------->   Ineffective

Process   <--------------------------->   Product

Innovation Effectiveness

Effective innovations enhance a desired outcome, whereas ineffective innovations do not. Accelerated middle schools are self-contained academic programs designed to help middle school students who are behind grade level catch up with their age peers. The What Works Clearinghouse found this innovation to be effective in enhancing students' progress through school.[6] Project DARE (Drug Abuse Resistance Education) is a popular school-based program intended to curb substance among adolescents. A number of rigorous studies have found it to be ineffective.

Most education innovations exist around the midpoint of the effective-ineffective dimension due to lack of evidence, i.e., they have not been evaluated or have not been evaluated with an approach that provides credible evidence. They may work. They may not. We do not know.

Unless effectiveness is thought of as a central dimension of innovation, the current innovation zeitgeist will subject the nation to yet another era of fad and fancy in education rather than continuous improvement. Note the previously cited position on innovation of the Knowledge Alliance, that we should, "turn the page on past efforts." Surely all past efforts weren't ineffective anymore than all efforts to "break-the-mold" will work: "idiocy can masquerade as innovation."[7]

We will have to invest in determining whether innovations are effective if we are to distinguish fool's gold from the real stuff and overcome the inherent attractiveness of the flashy new product. Determining whether innovations work will cost more and be more complicated in education that it is in many industrial and business settings because what we can easily measure, e.g., test scores, is usually an imperfect proxy of the actual outcome of interest, e.g., meaningful student learning. Further, the outcome of interest, student learning, is multiply determined and probabilistic (i.e., many students who experience an effective education innovation will perform worse than many students who are exposed to an ineffective innovation, and vice-versa). It is a very different matter to determine whether the iPhone is working than to determine whether charter schools are working. In the former case, sales pretty much tell the story. In the latter case, we need the expertise of a sophisticated discipline of evaluation within the social and behavioral sciences that has developed to deal with the challenge of determining whether social programs work. Some advocates of federal funding of product education innovation have taken the position that, "less than 5 percent of the … budget would be devoted to rigorous independent evaluations of the results achieved."[8] Imagine a proposal for the National Institutes of Health to provide substantial funding for medical entrepreneurs while investing only 5% in determining whether the resulting medical innovations actually enhance health!

Process vs. Product Innovation

Process innovation involves modifications of existing processes and procedures while product innovation is paradigm shifting. Getting teachers to better use quizzes to promote student learning is a process innovation whereas virtual schooling is a product innovation.

The process-product distinction is integral to thinking about innovation in the business sector. Apple's iPhone is a product innovation, whereas improving the software to allow the iPhone to better integrate with enterprise

networks is a process innovation. Process innovation is intended to improve efficiency, productivity, functionality, or customer satisfaction with respect to existing products. Product innovation introduces new products that may not initially have a customer base. Process innovation usually occurs through a lengthy process of accretion of small improvements based on, tinkering, feedback from customers, and benchmarking of the performance of competing products. And it is typically unheralded. Yet in business, success is frequently more dependent on process than product innovation. The difference between Southwest Airlines and the now defunct Northwest airlines was a matter of process innovation. Ditto the difference between Wal-Mart and Kmart and between Google and Yahoo.

Consider the following description of processes in an emergency room that saved the life of one child with serious trauma: "Scores of people had to carry out thousands of steps correctly: placing the heart-pump tubing into her without letting in air bubbles; maintaining the sterility of her lines, her open chest, the burr hole in her skull; keeping a temperamental battery of machines up and running. The degree of difficulty in any one of these steps is substantial. Then you must add the difficulties of orchestrating them in the right sequence, with nothing dropped, leaving some room for improvisation, but not too much."[9]

How is that different in principle from educating a student? And just as emergency rooms fail patients because simple steps are forgotten, so too do schools fail students because critical procedures are carried out sloppily or not at all. A nurse forgetting to wash his hands before changing a surgical dressing has an analog in a teacher who doesn't use quizzes to re-expose students to key content. The introduction of simple checklists in emergency rooms and surgical suites for routine procedures such as hand washing, having the patient confirm his identity, and checking for known allergies has substantial effects on outcomes such as mortality, number of complications, and time to recovery. If something as simple as a checklist can transform intensive care and surgery imagine what careful attention to routine processes could do in education.

What is the evidence on product and process innovation?

There are several current product innovations in education that have received a lot of attention, including instructional technology that aims to replace some of the functions of the classroom teacher, alternative routes into teaching such as Teach for America that aim to bypass schools of education and traditional certification, vouchers that break down the attendance barriers between public and private schools, and public charter schools that provide some of the flexibility of private schools and expand parental choice of schools while operating on public funds. The evidence on instructional technology is of high quality and disappointing.[10] The evidence on Teach for America is of high quality and encouraging.[11] The evidence on vouchers is out, but political support is waning. Charters are growing exponentially and have been blessed by the new administration.

Charters

Addressing the effectiveness of charters is important, particularly because the conceptual model behind them is clear (they are to replace traditional schools or cause existing schools to change to match charter competition) and their expansion is being strongly supported by the Obama administration.

Advocates for product innovation in education frequently rely on descriptions of exceptional charter schools to bolster their case for break-the-mold reforms. For example, President Obama's first school visit as president was to a charter school in Washington, D.C., Capital City Charter, in which the student body performs at much higher levels on district-wide academic achievement tests than students in DC public schools in general.

How does the school achieve relative success? One possibility is the effect of what the school advertises as

its innovative features, e.g., the use of the Expeditionary Learning Outward Bound whole school reform model, rich exposure to the arts, and hands-on experiences in science, math, and technology. However, another explanation looms large for the above average test scores for students attending this and many charter schools: selection bias. Capital City brags that it has more than 600 students on a waiting list for admission. It currently serves 236 students. The children who gain admission and those on the sidelines waiting to get in are not demographically typical of the DC public schools. For example, 34% are black and 43% qualify for free or reduced price lunch, whereas these percentages are 95% and 61% for the DC public schools as a whole. Further, parents who seek out the best available schools for their children and actively attempt to gain admission are not the same as more passive parents even if the measured demographics are identical.

This problem of differential selection into break-the-mold schools, as well as a higher dropout rate from those schools, bedevils many claims of their success. These issues are addressed by studies of charter schools that take advantage of the need of many charter schools to conduct lotteries for admission because they are oversubscribed. A comparison of achievement outcomes for students who won or lost the admissions lotteries provides an unbiased estimate of the impact of charter schools on children *whose parents tried to enroll their children in the oversubscribed schools*. Lottery-based studies of charter schools in Chicago[12], New York City[13], and Boston[14] have each found positive effects of charter attendance on reading and mathematics achievement.

These effects are noteworthy, but they likely overestimate the impact of all charter schools in the three cities because charter schools that were not in sufficient demand to be oversubscribed could not select their students via lottery and thus were not included in the analysis. Further, the results for the charter schools that were included can only be generalized to students whose parents wanted them to enroll them in those charters. These students and their families are likely to be different in important ways from students and families who were not motivated to enroll in a charter school or were willing to enroll in a charter school without a waiting list.

The NYC study examined the range of effects among charter schools. The effects of individual charter schools ranged from negative to strongly positive. Thus knowing that a school is organized around a charter governance model does not tell us whether it will be effective. The variable most strongly positively related to differences in impact among the NYC charters was length of the school year. We should consider the possibility that key ingredients of success for charter schools are process innovations such as providing more time for instruction rather than the product innovation of the governance model per se. If that is the case, and only more research will tell, it would suggest that traditional public schools can be made more effective by adopting similar process changes, e.g., longer school days and years. President Obama signaled support for just this process reform in his March 10 speech on education.

Note that there is also a range of success ranging from negative to positive among traditional public schools, and over 30 years of research on identification of the features that differentiate effective from ineffective schools. The conclusions from that research, e.g., the importance of high expectations for success and instructional leadership, are also features that are often viewed as characteristics of break-the-mold charters such as KIPP. The point is that our focus on the product innovation of charter schools needs to be balanced by a better understanding of the process innovations that lead to instructional success within both types of schools.

Improvements in traditional schools

Is it impossible to improve traditional schools, as many product reformers insist? Among many pieces of evidence to the contrary is a recent Brown Center report that finds that big city schools have made large academic gains in recent years and are closing the gap with their suburban and rural counterparts in their

respective states.[15] Case studies of large school districts that have made progress identify a variety of strategies that are driven by the central office, including establishing accountability systems that are much more detailed than required at the state and federal level and adopting district wide curricula and instructional approaches.[16] This top-down approach is poles apart from a portfolio model of charter school reform in which a thousand flowers are planted and some bloom.

Another source of evidence on the possibility of improvement of traditional schools is dramatically rising mathematics performance on the National Assessment of Education Progress. Average performance at fourth grade rose 14 points between 2000 and 2007, representing well over a year's worth of schooling. Increases were even larger (19 points) for students from low-income families.[17] There were no product reforms in mathematics during this period. Rather, process innovations that aligned instruction, curriculum, and professional development with common and well-known learning standards were likely to be at work.

Advocates for product innovation seem to resist the almost universal temptation among education reformers to look for models of education reform in countries that perform better than the U.S. on international exams. Perhaps that is because the education systems in the countries that are highest scoring on international tests typically do not support the portfolio model of charter schools that product innovators favor. High performing nations such as Singapore, Finland, Hong Kong-China, South Korea, and Japan have strong national ministries of education that set core curricula, implement high stakes examinations, exercise control over the selection, training, and work conditions of teachers, and monitor the performance of schools.

We have a reasonable body of evidence that centrally managed education systems that are designed to achieve a degree of uniformity in the delivery of education services, i.e., at least "good enough" schools, can work. On the other hand, we have very little evidence that a nationwide system of charter schools can succeed in providing a good enough education to all children.

What needs to be done?

We should continue to provide opportunities to incubate product innovation, e.g., by allowing charters to enter the market and operate with fewer strictures than traditional schools, by supporting virtual schools, by increasing our investments in instructional technology. But this should not distract us from the challenging, important, and unheralded task of making process improvements in the operation of traditional schools. After all, 95% of public schools in the nation are traditional rather than charters. Further, most process improvements that are developed for traditional schools should transfer to charter schools (and vice-versa). Investments in process innovation should improve the efficiency and effectiveness of education for all students.

The Innovation Fund

The American Recovery and Reinvestment Act of 2009 provides $650 million for an Innovation Fund through which the Secretary of Education is to make awards to local education agencies or nonprofits that have partnered with local education agencies. The purpose of the awards is to expand the work of the award winners and to identify and document best practices that can be shared and taken to scale based on demonstrated success. Demonstrated success is defined primarily as having significantly closed achievement gaps between the demographic groups for which results have to be reported under No Child Left Behind, for example, white and black students, and having exceeded state-established benchmarks for improvements in student proficiency under the No Child Left Behind Act.

Absent strong guidance from the Department of Education in its funding announcement for this program, there is going to be a bias in favor of applications from entities whose activities fall within the product sector of innovation. The Department needs to create a level playing field for product and process innovations.   It should be no more difficult in principle for an urban district to compete based on a process innovation than for a coalition of non-profits and charters to do so for a product innovation.

Applicants should be required to address selection bias in their presentation of data on their success in closing achievement gaps and meeting proficiency objectives. At minimum this would include a tabular presentation of annual *gains* on state assessments for students in the applicant education agency and students within the most similar surrounding schools, disaggregated by NCLB reporting categories. The reporting of gains from the end of one school year to the next is far preferable to reporting status scores at the end of a school year because it controls in part for differences in the knowledge and background of children who are served by different schools. There are better and more sophisticated ways to address selection bias than presenting comparisons of gains. Applicants ought to be scored on this dimension so that those who can most convincingly demonstrate that their success is due to value they added rather than the type of student they attracted would get more points.

The designers of the competition for the innovation awards should be sensitive to the great challenge of identifying and documenting best practices in education. In business settings a "best practice" is typically a process innovation that occurs in the context of a standard operating practice and is clearly associated with greater efficiency and effectiveness. For example, roof misting evaporative cooling systems have been shown to have lower installation, operating, and maintenance costs than conventional air conditioning systems in certain industrial settings. In this example, the practice, the outcome, and the improvement are clear and clearly related.

Parallels in education are hard to come by, particularly when the outcome is defined as closing achievement gaps and exceeding state objectives for proficiency under NCLB. Because of the threat of selection bias, it isn't usually clear whether schools that are beating the odds are doing so because of their practices or because the students they attract are more capable or motivated. When that problem is minimized, it usually isn't clear which practices were responsible for superior outcomes. Consider the successful charters identified in the studies in Chicago, New York City, and Boston. Are they successful because of instructional leadership, teachers, the extended school year, the involvement of parents, curriculum, or what? If we don't know what the best practice is, how can we document and replicate it?

In 2006, the Department of Education tried to put in place a process for identifying promising practices in education. This would have followed an earlier disappointing attempt to do the same that was mercifully shut down in the Clinton administration, the National Diffusion Network.[18] The designers of the 2006 initiative established criteria and coding schemes for promising practices, and to their credit, asked the National Academies of Science to form a panel to advise on the effort. One member of that panel, reflecting the general chagrin of many of his colleagues, commented that the effort was, "based on arbitrary, ad-hoc, undefended assumptions about some of the most difficult issues in the social sciences." The promising practices initiative never came to fruition because of the magnitude of the challenges to carrying it out.

Given that the legislative language for the Innovation Fund pushes the Department to identify best practices based on flimsy evidence, the competition for these awards might provide a competitive priority to applicants who offer the best plans for evaluating the effectiveness of their favored practices as they are expanded and scaled-up. The Department could also expend some of the administrative funds it has been granted to oversee the Recovery Act to provide technical assistance to Innovation Fund winners on how best to evaluate their programs going forward. It is very important to learn what works and what doesn't from the Innovation Fund investments.

Providing support for R&D on process innovation

It is hard to generate excitement around the gradual improvement of work-a-day processes. Yet there is a lot of evidence, some of it reviewed here, that successful organizations outside of education achieve high levels of performance because of a commitment to exactly that type of process improvement. The disparity in the appeal of process vs. product innovation is evident in the difference between the $650 million that Congress has appropriated for the Innovation Fund vs. the $230 million that it appropriates for the regular research budget of Department of Education, only a portion of which is devoted to funding R&D on process improvements in the operations of schools. Likewise, large philanthropies that support education R&D, such as the Bill and Malinda Gates Foundation, have shown a preference for product innovations. For Gates it was, until recently, smaller schools.

The R&D enterprise in education needs to invest more deeply and systematically in process innovations that will serve the practical needs of school districts and schools. One precondition for this shift will be for funders to value outcomes that are measured by increases in efficiency. Another will be to value outcomes that represent improvements in the contexts for learning and instruction even if those improvements cannot be causally linked to changes in student achievement. Currently it is difficult to obtain funding for education R&D that doesn't identify and measure changes in student achievement as the principal indicator of success. Student achievement is the most important outcome, to be sure, but not the only one on which R&D is needed. School districts need to hire teachers, contract for transportation, provide timely information to parents, comply with state and federal regulations, deal with health and safety, make payrolls, float bonds, purchase curriculum, use data intelligently, and so on. Doing some of these things better would simply save money, but that money could then be invested in higher teacher salaries or better instruction. Others would change the climate and culture of schools to better support productivity. And many would flow directly into student achievement.

Investing seriously in process innovation is a model for education reform that has not really been tried. Congress, the administration, major foundations, and organizations that advocate for public education need to support process innovation. We are unlikely to get dramatically better in educating students until we invest in engineering more efficient and effective tools and processes for carrying out the work of schools.

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