

# Experts detail the 3 rules for technological fixes

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Technology can do great things, but it also can be over sold as panacea for a host of social ills. A better use of technology can be gained if those who guide technology policy, and thus investment, are clear about how to apply it and know what to expect from their efforts.

This is the conclusion of an opinion piece in this week's (Dec. 18) *Nature* magazine written by Daniel Sarewitz of Arizona State University and Richard Nelson of Columbia University. Sarewitz and Nelson describe three rules that can help technology and science policy makers become smarter about where to apply technological fixes and what to expect as a result.

"These three rules can provide policy makers more clues about the appropriate types of investments and appropriate expectations for the outcomes of those investments," said Sarewitz, a professor of science and society and co-director of ASU's Consortium for Science and Policy Outcomes.

"They will help us be smarter about identifying situations where we can expect investments in R&D (research & development) to lead to rapid progress on social problems," Sarewitz added. "It also will help in distinguishing such situations from those where more R&D is unlikely to make much of a short- or medium-term contribution."

In "Three Rules for Technological Fixes," Sarewitz and Nelson use literacy education and disease prevention as contrasting examples of the complexity of applying technology in today's society. Both are seen as important for society, and both are the subjects of much research. But the existence of vaccines has allowed for great progress in disease prevention, whereas no comparably effective technology or methods exists for teaching children to read.

Their first rule is that technology must largely embody the cause-effect relationship connecting

problem to solution. For example, vaccines work with great reliability because they address almost all of the important variables necessary for preventing the disease. So, the application of vaccines is routinely done with great success despite "a notoriously dysfunctional health care system in the U.S."

Rule number two is that the effects of the technological fix must be assessable using relatively unambiguous or uncontroversial criteria. The benefits of the fix, that is, must be obvious to all.

"Such clarity (in benefit) allows policy and operational coordination to emerge among diverse actors and institutions, ranging from doctors and parents to school districts, insurance companies, vaccine manufacturers and regulatory bodies," Sarewitz and Nelson state.

From their earliest use, vaccines have provoked opposition on moral and practical grounds, a trend that continues today. But opposition to vaccines has not stemmed the long-term advance of vaccine technology. This is in part because their effectiveness is hard to argue against, and because continual improvement has tended to answer objections about efficacy and risk.

This success is in stark contrast to the teaching of reading (education) "for which no particular method or theory has been able to achieve long-term or widespread dominance, and for which compelling evidence of improved efficacy even over timescales of a century is lacking," they state — despite the many methods and technologies that have been developed to improve literacy.

Rule number three is that research and development is most likely to contribute decisively to solving a social problem when it focuses on improving a standardized technical core that already exists. In other words, science is at its best

when it improves upon a scientific base (like vaccine technology) than elucidating theoretical foundations, causes or dynamics of a problem (like how people do or do not learn).

"For vaccination, the standardized core, the vaccine – first developed more than two centuries ago not through basic research but through empiricism guided by folk wisdom – remains the fulcrum on which cumulative learning and improved practice can be leveraged," they add.

Sarewitz and Nelson state that when knowledge is not largely embodied in an effective technology, but must be applied to practice, through training, incentives, organizational structures or public policies, the difficulty of improving outcomes is greatly amplified.

In summary, Sarewitz says: "When technologies meet our three rules, they are particularly powerful because they are better able to overcome the political and organizational obstacles that often make social progress so frustratingly slow."

Sarewitz said that in addition to these three rules, it is important for policy makers to know when to be skeptical about the social value of technology.

When the three rules are not met, "R&D programs aimed at solving particular social problems should neither be expected to succeed, nor be advertised as having much promise of succeeding in the short or medium term," he said. "Rather, they should be understood and described as creating fundamental knowledge and the exploration of new approaches with success possible only over the long term and with a significant chance of failure."

"In a world of limited resources, the trick is to distinguish problems that are amenable to technological fixes from those that are not," he added.

Source: Arizona State University

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