

Similarities and differences among seven research approaches in socio-ecological systems: insights from the 2017 Schön-Stokes model of research

Research is one or any combination of the following three human activities or processes:

- (1) investigation or experimentation aimed at the discovery and interpretation of facts;
- (2) revision of accepted theories or laws in the light of new facts;
- (3) practical application of such new or revised theories or laws.

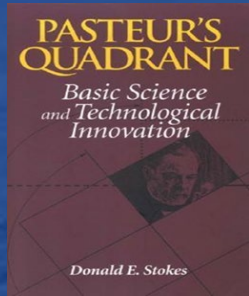
(Merriam-Webster.com Dictionary 2020; parentheses and semicolons by the author)

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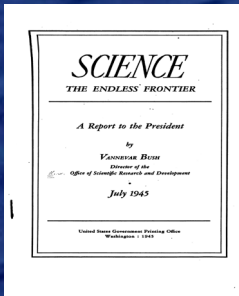
The 1997 Stokes quadrant model of research in science and technology (Stokes 1997, p.73): an instructive framework of research for scientific and technological innovations



Donald E. Stokes
(1927-1997)



Vannevar Bush
(1890–1974,
the first US
presidential
science advisor)



Quest for
fundamental
understanding

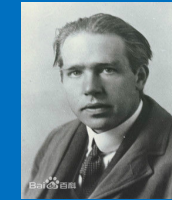
Yes

no

Bohr's quadrant

pure basic research
for understanding

Niels Bohr (1885-1962)
Danish physicist, the 1922
Nobel laureate in physics



Pasteur's quadrant

use-inspired basic research
for understanding and use

Louis Pasteur (1822-2895)
French microbiologist, known
for, inter alia, pasteurization



Edison's quadrant

pure applied research
for use

Thomas Edison (1847-1931)
American inventor, holding
1,093 US patents in his name



no

yes

Consideration of use

Basic research → Applied research → Development → Production and operations

The 1945 Bush linear model of research
in science and technology (Stokes 1997, p.10)

The 2017 Schön-Stokes model of research in socio-ecological systems (Xiang 2017, pp.2242-2246) : an instructive framework of socio-ecological practice and research



George Box
(1919-2013)



John Sterman

Models are nothing,
modeling is everything

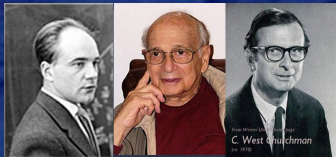
(Box 1976, p.792; Sterman
2002, p.521)



Donald E. Stokes
(1927-1997)



Donald Schön
(1930-1997)



Rittel Webber Churchman
(30-90) (20-06) (13-04)

Quest for
fundamental
Understanding

& Interest in
tame problems
of “high
ground”

∞

Bohr—Fuller’s quadrant

pure basic
research for
Und.



R. Buckminster Fuller (1895-1983),
American architect known for, inter alia, his
1960 dome-over-Manhattan idea (1964)

curiosity-inspired research
for knowledge brokering



Pasteur—McHarg’s quadrant

use-inspired basic
Research for
Und. & Use



Ian McHarg (1920-2001) Scottish-
American landscape planner, the
Woodlands, “Design with Nature”

Use-inspired practice
research for Use & Und.



Johnson’s quadrant

free roaming
precursors of research in Bohr’s
and/or Edison’s quadrant



Paul Johnson (1928—present)
British historian

Edison—Li’s quadrant

pure applied
research for use



Use-inspired practice
research for use

Li Bing [?] engineer in chief, the
Dujiangyan Irrigation system,
China (256 BC)



0

0

∞

Consideration of use & Interest in wicked problems of “lowlands”

“Physics and chemistry, science and engineering, literature and philosophy, art and industrial design, theory and practice—all constituted a continuum of knowledge and skill, within which men roamed freely. The notion of separate, compartmentalized ‘disciplines,’ later imposed by universities, did not yet exist.” (Johnson 1992, p.543)

Two SES research approaches in Bohr-Fuller's quadrant

	pure basic research	Knowledge brokering research
Stance on research	Basic research should and can be motivated “solely by the quest for understanding (of the tame problems of the high ground—the author) without thought of practical use.”(Stokes 1997, p.73)	Through a knowledge transfer process, the pure, objective, and rational knowledge can be made relevant to and even actionable for the solution of wicked problems of the lowlands (Schön 2001, pp.192-193; Xiang 2016, p.59)
Interest	Development of theories of scientific principles	Practical demonstration of the scientific principles (Buchanan 1992, p.19)
Goal	To generate “pure, objective, and rational” knowledge (Cook and Spray 2012, p.93)	To inform, influence, or even direct practitioners (Egoh et al. 2008, p.135)
Research strategy	To follow the logic of modern science: objective, context-independent, and reductive, <i>inter alia</i>	To follow the logic of modern science, but often if not always have to take “procrustean strategies” (Schön 2001, p.192)

Two SES research approaches in Pasteur's quadrant

	use-inspired basic research by scholar-scientists for understanding & use (Stokes 1997, p.15)	use-inspired practice research by scholar-practitioners for use & understanding (Stokes 1997, p.15; Xiang 2019a, p.7 & 9; 2019b, p.165)
Stance on research	basic research should and can be ambitious of producing new knowledge for practice; as such, it takes practice as its objects of study and produces solutions	To be useful to the real-world practitioners who are in specific knowledge needs under particular circumstances of socio-ecological practice, a piece of knowledge needs to be directly relevant, immediately actionable, and foreseeably efficacious can be motivated by the dual of practice and producing new knowledge in particular instances of practice as the totality of the practice
Interest	development of useful, scientific knowledge for practitioners, and discovery of new scientific principles	development of useful knowledge of all kinds and making sure that it is used to produce desirable results practitioners care about; building industrial benchmarks and protocols (i.e., SITES)
Goal	“to extend the frontiers of understanding but is also inspired by considerations of use. ” (Stokes, 1997, p.74)	“to generate new knowledge that is useful to practitioners and enlightening to fellow scholars” (Xiang 2019a, p. 7 and p.9; 2019b, p.165).
Research strategy	From practice, for practice, beyond practice To follow the logic of modern science and respect the logic of practice	From practice, for practice, beyond practice To exercise moral improvisation (through the master skill par excellence of ecophronesis —ecological practical wisdom) To sustain a carefully nuanced balance between the logic of practice and that of science in a particular instance of socio-ecological practice research