The Rational and Definition of Applied Research in Polytechnics

Gary Bertoline
Dean & Distinguished Professor

Polytechnic Summit
June 7, 2017
HISTORICAL CONTEXT

GREEK CULTURE

• Begin with the influences of ancient Greek culture.
• Severed inquiry from use.
• Reinforced in Greek civilization by the consignment of the practical arts to people of lesser class and manual labor increasingly to slaves.
• Practical utility was rejected as a legitimate end of natural philosophy.
• Set in motion a tension that remains today between pure and applied research or research to gain new knowledge and research for practical use.
After the recognition by our nation’s leaders for the important role that research played in World War II, Bush was commissioned by President Roosevelt to submit a report recommending how research should be supported by the Federal government in peacetime.

His subsequent report titled *Science, the Endless Frontier*, has as its first canon that basic research is performed without thought of practical ends (Bush, 1945).

Its second canon states that basic research is the pacemaker of technological improvement.

Bush’s views continued the tension between basic and applied research in our nation.
Of course there is much pure research that is undertaken without regard for use or application.

A classic example is the work of Niels Bohr’s work in physics on the structure of the atom which can be classified as pure basic research.
Many examples of applied or use inspired research that actually contributed to our basic understanding of nature.

Pasteur is a classic example who wanted to understand fundamental laws of nature but he was inspired not through his desire to create new knowledge but to solve practical problems related to specific diseases.

Pasteur’s work is an example of the rise of a new scientific discipline, microbiology, in the late 19th century that was a new branch of inquiry created out of the effort to cure diseases and not only for the quest for fundamental understanding. This is an example of use-inspired basic research.
Research furthest removed from pure basic research is the type that was undertaken by Thomas Edison. Edison’s classic work on finding a filament for a light bulb is an example.

Edison had no desire to understand the science underlying his discovery to make a working light bulb.

It was left to other scientists to consider its more fundamental implications for the Edison Effect which eventually led to a Noble prize for Rosenberg and Thompson for discovering the electron.
Edison’s research can be categorized as *pure applied research*. A great deal of modern research belongs in this category and is extremely sophisticated although narrowly targeted on “immediate” applied goals. The immediacy of the research is a distinguishing characteristic of the research that is of primary interest for 21st Century Polytechnics.
Stokes advocates that from these three forms of research you can create a model to better understand and explain the goals and roles for various forms of research.

Stokes calls his model Pasteur’s Quadrant Model of Scientific Research.

This model represents the 3 forms of research that are commonly undertaken and described earlier.
PASTEUR’S QUADRANT

Pure basic research

Use-inspired basic research

Tinkering

Pure applied research

Bohr

Pasteur

Edison

Relevance for generalized knowledge

Relevance for immediate applications
TRANSLATIONAL RESEARCH

- Pasteur’s Model can be modified to represent the more dynamic nature of research and the interaction that can occur between pure basic research, use-inspired research, and pure applied research.
- The model shows the clear need to represent the dual, upward path as interactive but semiautonomous.
- Science often moves from existing to a higher level of understanding through pure research where technology has little influence.
- Technology often moves from an existing to an improved capacity by narrowly targeted research, or by engineering or design changes, or by simple tinkering at the bench, where science has little influence.
- Each of the paths is at times generally influenced by the other, and this influence can move in either direction, with use-inspired basic research often serving as the connecting role.
Faculty in Polytechnics engaged in Discovery have many opportunities to engage in research which is use-inspired and pure applied research.

- Corporate partnerships will frequently initiate this type of work, or faculty may initiate it in partnership with them.

- This can be done in a scholarly manner and in many cases following the same rigor and publication standards one would employ when engaged in pure basic research.
Another line of research that Polytechnics can pursue relates to a 21st century economy that is based on the capacity of society to constantly innovate.

The capacity to innovate is fast becoming the most important determinant of economic growth and a nation’s ability to compete and prosper in the 21st century global economy.

Innovation encompasses not only research and the creation of new ideas, but also the development and effective implementation of the technology into competitive products and services.
• To foster new research thrusts the creation of organized research units (ORU) has a very successful track record in higher education.
• There are three kinds of ORU’s: interdisciplinary centers, scientific institutes, and consumer-oriented centers, which primarily serve the needs of sponsors.
• The consumer-oriented centers can define their research objectives around “core technologies” rather than the more traditional subject matter.
Perfecting and advancing technologies is a scientific challenge in itself, requiring specific assignment of faculty, postdocs, research staff, and graduate students.

The upside to doing so has two positive dimensions.

- The technologies will be used by and interact with basic research in other fields in the university.
- There will be applications to commercial technologies that may take the form of spin-off companies, patent licensing, or research partnerships with business and industry.
Gary Bertoline
Dean & Distinguished Professor
Purdue Polytechnic Institute
bertoline@purdue.edu

Purdue Polytechnic Institute
polytechnic.purdue.edu

/ TechPurdue