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Polytechnic Education – A Proposed Key to Regional Economic Development

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Abstract

Increasingly, institutes of higher education are being influenced by state and local governments to demonstrate "value for money," particularly in the offering of "occupational-professional" programs, as well as producing educational, technological and scientific accomplishments associated with innovation and economic prosperity. This market-based utilitarianism (which differs from the liberal arts traditions of education) has led public and private institutions to develop and implement new "polytechnic" campuses, thought to specifically address these goals. A typical polytechnic strategic plan emphasizes an interdisciplinary campus environment, innovative instructional technologies, experiential and applied problem-based learning, applied research, disciplinary convergence, and community and global engagement, so that sustainable educational and economic progress can be demonstrated. Of particular interest to students and faculties in polytechnics is the emphasis on Science, Technology, Engineering, and Mathematics (STEM) education - where applied learning, research and technology prepare students to be innovators and entrepreneurs in knowledge-based economies by more closely connecting academia with industry.

Key words: Polytechnic, STEM, economic development, experiential learning, interdisciplinary problem solving

Introduction

A major educational philosophy, the "liberal arts", was established in classical antiquity, and reemerged in the United States in the 19th century. This educational approach is characterized by the concept that "knowledge is pursued 'disinterestedly,' " i.e., "without regard to political, economic or practical benefit" (1). Using this concept, Charles William Eliot, president of Harvard University for 40 years, established the ubiquitous concept of "…a liberal arts degree followed by graduate or professional school" to produce the "occupation/profession" of the liberally educated student (1). Abraham Flexner extended this approach to professionalize medical education, but added his personal view of education "marked by small classes, personal attention, and hands-on teaching" (2).

Liberal arts institutions generally offer a curriculum "aimed at imparting general knowledge and developing general intellectual capacities, in contrast to a professional, vocational, or technical curriculum" (3). Liberal arts studies often include literature, languages, philosophy, history, mathematics and science. Perspectives in these fields are studied broadly, while vocational and/or technological education had historically been perceived as "insularizing" and "provincializing" rather than "liberating" (4).

The "Practice/Occupational" shift

As a response to the Industrial Revolution and changes in social class hierarchy in the early to mid 20th century, higher education began to shift its focus to the teaching

of agriculture, science and engineering rather than the historical emphasis upon the liberal arts (5). A Civil War Congress passed the Morrill Act (5) establishing land grant colleges. The grant was set up to establish institutions in each state that would educate people in professions that emphasized applied economic sustainability and assure that "education would be available to those in all social classes" (5). Subsequently, the Hatch Act (5) established the Agricultural Experiment Station, "… to conduct research that encompasses the continuum of fundamental and applied research for the purpose of developing new knowledge and technologies that address specific problems… research focused on the discovery of solutions and the development of educational programs that disseminate knowledge and technology to an identified clientele." In addition, the Smith-Lever Act (5) established the Cooperative Extension Service so that land-grant institutions could "extend" their resources, solving public needs with college or university resources through non-formal, non-credit programs. Higher education then encompassed a spectrum, extending from expanding general knowledge to specific application and problem solving.

"Polytechnic" model

This "practical/occupational" approach to education in the land grants was reflected in early polytechnic schools, with a distinct interest in science and technical fields such as engineering. The land grants and polytechnics each embraced the statement attributed to Aristotle, "For the things we have to learn before we can do them, we learn by doing them (6)." For example, the École Polytechnique was founded by Napoleon to address the needs of the State for scientific and technical managers (7). Students of differing academic achievement levels began classes in 1794, focused on providing "solid scientific formation, supported on mathematics, physics and chemistry" that would "prepare them for entry into the special Civil Service schools" (7).

The oldest technological university in the United States is Rensselaer Polytechnic Institute. Founded in 1824 as the Rensselaer School, the institution was created "for the purpose of instructing persons…in the application of science to the common purposes of life" (8). In 1833 the school became the Rensselaer Institute, changed to Rensselaer Polytechnic Institute in 1861. Rensselaer's primary focus was science and civil engineering, applying "engineering solutions to national and international needs and challenges" and emphasizing "unique educational strategies" such as engaging students as teachers and in the performance of scientific experiments. "Application of knowledge" was a completely different expected outcome from "disinterested, broad-based learning with no specific economic application."

Rose Polytechnic Institute was later founded in 1874 "for the intellectual and practical education of young men" (9). Its charter established its focus in the "mechanical arts and sciences" as well as "useful and practical knowledge of some art trade or occupation" that would enable its students "to earn a competent living" (Charter signed September, 1874, Terre Haute, IN). By 1903 the institute's curricula focused on five engineering disciplines: mechanical, civil, electrical, architectural and chemical. Degree programs in mathematics, physics and chemistry were added in 1958. In 1971 the college was renamed as the Rose-Hulman Institute of Technology, and women were first admitted to the college in 1995. Throughout its evolution, Rose-Hulman has maintained its commitment to "develop students academically, culturally, physically, and socially so that they can make significant contributions to the nation's economy, the resolution of social problems, and the welfare of the human race" (10).

Expansion of "applied" higher education in the 1960s in England, Wales and Northern Ireland enabled polytechnics there to award degrees. The polytechnics offered both academic and professional vocational subjects, focusing on applied education for work and concentrating initially on engineering and applied science. Later, under the Further and Higher Education Act 1992, the polytechnics became full-fledged universities, changing their names when they gained university status (11).

Common threads

In the United States, the land grant and polytechnic educational models have a commonality – the practical completion of which is an occupation which is useful and immediately productive for society. Pedagogical approaches in polytechnics embrace student-centered, experiential learning, favored by John Dewey and grounded in the making of meaning from direct experience. (12). This is clearly opposed to the liberal arts model, which had traditionally been designed to impart general knowledge while developing students' intellectual capabilities.

This cultural shift has already had an impact on American higher education. In the 70s and 80s, the range of occu-

pational/vocational programs offered by institutions of higher education expanded dramatically. As pointed out by Brint, et al., polytechnic "occupational-professional" education is not only well established in American higher education, but "occupational fields have accounted for 60% of bachelor's degrees in recent years, up from 45% in the 1960s" (5).

Student goals

Student perceptions of the goals of a college education have shifted as well. In the late 60's, eighty percent of students participating in The American Freshman survey selected "developing a meaningful philosophy of life" as very important. By the late 70's, students predominantly chose "being very well off financially" as their primary goal (13). The American Freshman Forty-Year Trends 1966 – 2006, published by the UCLA Higher Education Research Institute (14), indicated that for entering college students, the most important goals were "raising a family" (75.5%), "being well-off financially" (73.4%), and "helping others" (66.7%). In 1976 and 2006, students indicated the two most important reasons for attending college were "To learn about things that interest me" and "To get a better job." In 2006, sixty-nine percent of students indicated "To be able to make more money" was a very important reason for going to college, compared with 49.9% of incoming students in 1976. Also in 2006, 66.5% of students indicated that "the chief benefit of a college education is that it increases one's earning power." A combination of market forces along with social/economic conditions have encouraged older students to return to school for a fast-track into a new occupation. Also, new fields such as computer and information services, technological advances in health care and other fields requiring new skill sets and competencies, benefit from the "hands-on" approaches characteristic of polytechnic education. Common threads of the missions of the ten U.S. polytechnics make "occupational/professional" programs attractive.

Workforce and economic needs

"Are They Really Ready To Work?" is a report of employers' perspectives on the basic knowledge and applied skills of new entrants to the 21st Century U.S. Workforce (15). The report identifies basic knowledge/skills that are "fundamental" for new entrants: English language (spoken), reading comprehension (in English), writing in English, mathematics, science, government/economics, humanities/arts, foreign languages, history/geography. However, the report also identifies applied skills that "enable new entrants to use basic knowledge acquired in school to perform in the workplace". These applied skills are: thinking/problem solving, oral communications, written communications, teamwork/collaboration, diversity, information technology application, leadership, creativity/innovation, lifelong learning/self-direction, professionalism/work ethic, ethics/social responsibility.

Polytechnics may answer workforce and economic needs

Opportunities for students to understand how learning connects to careers or to solving real-world problems through project-based learning are considered important to the cultivation of applied skills needed in the workplace. The report further indicates that 75.6% of employer respondents say K-12 schools should be responsible for providing the necessary basic knowledge and applied skills for new business entrants; 68.4% say four-year colleges and universities and 45.2% say two-year colleges are responsible. Julie Ruben has suggested that "stimulating economic growth has come to be viewed as the primary social benefit of higher education" (16).

Polytechnics are designed and well-situated to contribute to workforce and economic growth. "Polytechnics are comprehensive universities offering professional, career-focused programs in the arts, social and related behavioral sciences, engineering, education, and natural sciences and technology that engage students in active, applied learning, theory and research essential to the future of society, business and industry," according to Chancellor Charles W. Sorenson, University of Wisconsin-Stout (Polytechnic).

There are ten universities in the U.S. that include "polytechnic" in their names, these are presented in Table 1.

Polytechnics are designed blend theory and practice to solve "real world problems for the benefit of society" (17). The missions of these polytechnics share common commitments that reflect this perspective, as well as the applied skills essential to a 21st century workplace, as shown in Table 2.

Employment prospects for graduates are promising. Polytechnics report high placement rates of graduates. At Cal Poly San Luis Obispo, for example, 2009-2010 graduates report job offers before graduation; 82% with jobs 3 months after graduation; 97% with jobs 9 months after

Table 1.
Ten Universities in the U.S. that Include "Polytechnic" in their Names

Arizona State University Polytechnic Campus, (Mesa, AZ)

California Polytechnic State University, (Pomona and San Luis Obispo, CA)

Northwestern Polytechnic University, (Fremont, CA)

Polytechnic Institute of New York University, (Brooklyn, NY)

Rensselaer Polytechnic Institute, (Troy, NY)

Southern Polytechnic State University, (Marietta, GA)

University of South Florida Polytechnic, (Lakeland, FL)

University of Wisconsin-Stout, Wisconsin's Polytechnic University, (Menomonie, WI)

Virginia Polytechnic Institute and State University, (Blacksburg, VA)

Worcester Polytechnic Institute, (Worcester, MA)

Table 2.
Skills emphasized in polytechnical education and training

- Emphasis on science, technology and professional and technical programs, complemented by arts, humanities and social sciences
- Smaller class sizes
- Integrated curriculum, practical and theoretical exercises throughout programs
- Hands-on, project- and team-based learning environment
- Applied, collaborative research and technology transfer
- Cross-disciplinary and co-curricular experiences, internships and service learning across disciplines
- Social responsibility
- Civic engagement
- Innovation, entrepreneurship
- Leadership in scientific, economic and community development
- Adaptation/responsiveness to needs/demands of business, industry and society

graduation; 90% in jobs related to their field of study. A March 2010 report on 2008-2009 graduates indicates an average salary of $51,000 annually. The Polytechnic Institute of New York University reports more than 89% of its undergraduate students receive job offers within 6 months of graduation with a median annual salary of $62,400. Rensselaer Polytechnic Institute reported that 71% of its 2009 graduates were employed with a median salary of $56,797. The University of Wisconsin – Stout reports that of its fall 2010 graduates, 97% were employed with 74% employed in their field of study.

A Case Study in Regional Economic Development - Florida Embraces the Polytechnic Educational Trend

In 2010, Florida elected a businessman (with no political experience) to run the state in a more business-like manner: "New Florida Governor Rick Scott (Businessman) Promises to Add Jobs and Cut Taxes" (17). The reason for his election: current economic conditions in Florida, as in many states, are declining. "The economic situation of Florida is precarious at best, and with foreclosures, cost of living, gas prices and health care costs increasing, our communities are having to deal with problems across the board (in South Florida, unemployment is 13.4%)"(18,19).

As seen in other states, aligning the development of polytechnic academic programs with industry clusters provides significant opportunity for the polytechnic to contribute to local economic development. Developing a state polytechnic university is part of Florida's economic recovery solution. For example, an economic impact analysis indicates an aggregate economic impact of $3.2B with a $1.3B impact on earnings generated by an additional 36,610 jobs. National market trends and forecasts support future growth prospects for identified clusters. Central Florida offers foundational assets to support further development of the proposed clusters into high growth and high value-added niches (20, 21).

In most cases, the vision of a university based on a polytechnic model often begins with a vision of a destination campus ("...nearly three million students now study outside their home campus") where applied learning, research and technology would prepare students to be innovators and entrepreneurs who would lead change locally and globally (22). The next step in building a new state university requires cooperation between political, community and academic constituencies, often with competing interests.

In July 2008 the Florida State Legislature established the University of South Florida Polytechnic (renaming an existing regional campus), the state's first and only polytechnic university. The goal, "…the Polytechnic campus will focus on the important high-tech fields of the future. The polytechnic concept ensures that even graduates in degree programs outside of the Science, Technology, Engineering, and Mathematics (STEM) areas will have training and education in those areas and develop skills applicable to the 21st century economy. Additionally, the construction of this campus will allow the state university system to continue to meet the growing demand for access." (23)

Since state budgets for education are shrinking and the overall availability of funds is considered a "zero-sum" prospect, the discussion of oversight of the "regional" nature of USF Polytechnic became a contentious topic. In an unexpected move, the Florida legislature separated the new polytechnic from USF (as it was originally commissioned) and made it an independent entity, the 12th state university, with a view of broadening the economic influence, even though the leadership of USF Tampa was firmly established and considered crucial for a new venture. (24)

Conclusions

Presently, scientific innovation and workforce development have become important topics in the debate on how best to rejuvenate the U.S. economy. The polytechnic university is seen to be one answer to reversing difficult economic environments.

For example, in common with other newly industrialized economies in Asia, Singapore is moving toward a knowledge-based strategy by stimulating economic growth through industrially relevant research, technology commercialization, high-tech spin-offs, attracting foreign talent, and inculcating entrepreneurial mindsets. (25) In New York City, Mayor Bloomberg, NYU President Sexton and MTA Chair Lhota have announced a partnership to create a new Applied Sciences center in Brooklyn as part of the Applied Sciences NYC Initiative. The center is expected to generate $5.5 billion in economic impact including 7,700 jobs over three decades. (26) As education leaders and policymakers debate how best to reengi-

neer the university learning experience, there is a "quiet renaissance occurring at polytechnic institutions where the captains of engineering innovation are educated in the new global economy." (27) On the other hand, The Grattan Institute's John Daley and Annette Lancy in The Conversation suggested that regional universities are failing to have economic impacts, and that investment in regional universities is largely wasted in efforts to stimulate regional development. This position was rebutted. (28).

Even though "polytechnic-like" education has been readily available for over 150 years, the parallel concept of "applied" education is enjoying resurgence around the world to (as postulated) promote economic development and improve the quality of life of involved communities. The final outcome of this strategy is currently being debated, financial commitments are being made but the effects remain to be measured.

Disclaimer

This serves as an affirmation that claims are those of the author, employed by the University of South Florida; [b.] the work was not directly subsidized and/or contracted by a private or commercial enterprise

Competing interests

The authors declare that they have no competing interests.

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