

The Polytech Model of Secondary Education

Towards Global Leadership in Advanced Manufacturing

Introduction

For several decades, the value of education linked to manufacturing has been diminished at all levels within the American educational system. This is due primarily to the combination of the history of discrimination of tracking minority students into undesirable careers and the exclusive focus of national education policy on a 'college for all' agenda. Careers in production have generally been seen as less important and appealing to our youth exacerbated by the mainstream perception that manufacturing is a diminishing industry. As a result, our vocational education system has been dismantled and meaningful linkages to a changing and dynamic productive sector frayed.

The powerful linkage between manufacturing and STEM education isn't widely recognized nor acknowledged. An education system focused primarily on college prep and standardized testing results in lost opportunities for contextual education and the creation of multiple pathways to prosperity through a direct link between education and the economy. We have the dilemma of high unemployment yet 3,000,000 good jobs unfilled including 600,000 in manufacturing. On average these jobs pay \$75,000 a year in salary and benefits. As a result, we now are challenged by our growing number of competitors in the global economy who are giving new emphasis to education linked to production. The consequence of this disconnect between education and production is now being acknowledged by the President and his administration, by leading large and small companies, and by a growing number of educational institutions and leaders. There are a growing number of practitioners and policy makers who want to do something about this and some actually are.

The Polytech Model is intended to provide a foundation for community development, industrial retention, and reindustrialization by inspiring and preparing the next generation of leaders in all aspects of advanced manufacturing. Unlike traditional vocational education, which prepares students only for work on the shop floor, Polytech schools prepare students for leadership at all levels of advanced manufacturing, including skilled production, engineering, management, and ownership, as well as related fields like intellectual property law, finance, policy, human relations, and science.

The Model

In partnership with the Chicago Manufacturing Renaissance Council (CMRC, www.chicagomanufacturing.org), CLCR has developed the Polytech Model of Education. In 2007, we founded Austin Polytech Academy (APA, www.austinpolytech.org)—a Chicago public school as the first application of this model. The Polytech Model has three primary, interrelated aspects:

1. Linkage to Advanced Manufacturing
2. Superior Academic Performance
3. A Deep Commitment to Equity, Access, and Development for All Communities

The intention is for Polytech schools to go beyond traditional vocational or trade schools in terms of preparation and post-academic opportunities. At minimum, the Polytech Model is a method of preparing graduates to have choices. Our objective is for *every Polytech graduate to have a choice of going to a good four-year college, a family sustaining job or both.*

Polytech schools accomplish this objective through building a foundation of essential partnerships including: educators, manufacturing companies and their associations, the teachers unions, local government and its public school system, and the broader community. Each is required for the core components of this model and its success, and the absence or failure of any partner can prevent success. The central role of public school systems and teachers unions are key prerequisites for taking the model to scale and in enough time to preserve and extend our countries' competitive advantage in advanced manufacturing.

1. The Linkage to Advanced Manufacturing

Our approach is premised on the knowledge that we must re-discover, re-define and rebuild manufacturing if we are to have and advanced a sustainable society. Manufacturing is the only sector that can build a broad-based middle class and significantly reduce poverty. It is the only sector that can solve the environmental crisis. It is a sector that can provide careers that build human capacity during work as well as provide a high standard of living outside of work. The Polytech Model provides a foundation for industrial retention and reindustrialization.

We can maintain and expand our advantage in advanced manufacturing only by building a world class K-20 education system. The Polytech Model school links education to advanced manufacturing through the following elements:

- A. Industry contact and workplace experience begins early in the student's high school career, possibly even in the summer before school starts.
 - i. Regular field trips to manufacturing companies, industry shows, and universities are essential.
 - ii. Industry professionals should interact with students as often as possible.
 - o Academic teachers without manufacturing experience must also become familiar with the industry, so these visits benefit them as well.
 - iii. As students develop maturity and soft skills they are connected to job shadowing opportunities.
 - iv. Once a student is academically, socially and legally ready to work he can be placed in summer or Spring Break internships.
 - v. Finally, students interested in pursuing full-time, career-track employment after high school can receive job coaching assistance to interview with local manufacturers during their senior year of school.
- B. In order to facilitate industry contact, Polytech schools require at least one dedicated and experienced Industry Coordinator. Since most manufacturers will have never worked with a high

school or high-school aged youth, the Industry Coordinator is the essential link connecting the school with the manufacturing industry. The importance of active industry partners in all levels of school activities cannot be overstated.

- C. The Polytech Model requires both specialized foundational competencies and specific technical competencies.
- i. For example, a pre-engineering curriculum such as *Project Lead the Way* should be combined with hands-on computer numerical controlled (CNC) machining training toward one or more industry-recognized credentials.
 - ii. Technical curricula must teach to industry skill standards. Outcomes must be student attainment of industry-recognized credentials, if such standards exist for the industry subsector. These schools utilize the NAM-Endorsed Manufacturing Skills Certification System. If possible, these should be competency-based. Different manufacturing subsectors have different standards. Not all subsectors have standards.
 - o A skill standard is a compilation of the skills, or behaviors, required to adequately perform a particular specified job for multiple employers. The best standards contain all the skills necessary to perform the job, with each skill being measured such that that employee and employer both know if competency has been attained.
 - o Competency-based testing measures the ability to actually perform required tasks, such as repairing a programmable logic controller. Knowledge and competency is not the same thing.
 - For example, the National Institute of Metalworking Skills (NIMS) requires students to complete a written knowledge test and also manufacture a part to specifications.
 - o From the student's viewpoint the most valuable credentials are portable, or in other words, recognized by multiple employers. Generally, the wider the group of employers involved, the more portable the standard.
- D. Academic curricula should include contextual material related to manufacturing.
- i. A strong academic foundation in science, technology, engineering, and math is essential for students who aspire to become leaders in advanced manufacturing.
 - ii. Subjects in the humanities are important areas to integrate concepts related to innovation and technology to skillsets such as communication, critical thinking and creativity and are extremely useful to anyone who may someday supervise others, work on teams, or collaborate with diverse people.
 - iii. Courses on business and entrepreneurial development reflecting the values of social, economic, and environmental sustainability are central to the themes of manufacturing.
- E. Diverse extra-curricular activities reinforce the curriculum and further involve company partners. Some examples include robotics, SkillsUSA, environmental clubs and student-run businesses.

- F. Polytech schools must model the workplace as much as possible. Teenagers will be teenagers, but expectations of student behavior in the classroom should align with what would be expected of the young person in the workplace.

2. Superior Academic Performance

The more education a student has, the higher they can go in the firm and in the manufacturing sector. Manufacturing companies also value a strong work ethic, the desire to learn, the ability to communicate, and skill in working with groups as well. Those qualities can often lead to a job in a company and an opportunity to pursue additional education.

The Polytech Model school should include the following academic programmatic elements:

- A. Polytech schools must be successful as schools. All the essential ingredients of any successful school must be in place including:
 - i. Inspired Teaching – All teachers must be able to demonstrate the competencies they are teaching. They must captivate the attention of students, and must be good classroom managers.
 - ii. Safety.
 - iii. Nurturing Environment – Polytech schools must be conducive to learning, meaning student and faculty behavior must be appropriate.
 - o The Polytech model favors positive behavior support—in other words, rewarding positive behavior rather than punishing negative behavior.
 - o Every student is different, so Polytech schools must employ a full repertoire of behavior management techniques.
 - iv. Strong Curriculum – Polytech schools must include a rigorous core curriculum and evidence-based educational methodology to give each incoming student all the tools necessary to meet performance objectives.
 - v. Strong school culture supporting the mission and that celebrates hard work, achievement, ambition, competition, and teamwork – Polytech school leaders must find ways to continually reinforce the mission of the school in all school operations. This may be done through a variety of ways including ongoing professional development, teacher evaluation, school-wide incentives and school-pride activities.
- B. An evidence-based method of remedial learning must be in place to advance students to grade level. The Polytech model was originally designed for urban settings, where the vast majority of students enter ninth grade performing substantially below grade level. Of course every student will not require remediation but if the Polytech Model is to serve an equity agenda this full sequence must be available, and will probably be needed by the majority of students.

- i. The method chosen must provide accelerated remediation. Students must often leap several grade levels forward in basic skills early in their high school career.
 - o Direct instruction is one possible evidence-based approach. The Safer Foundation peer learning model is another.
 - ii. Certain states, such as Illinois, will not grant high school credit for subject matter below grade level. However, remediation must precede full grade level instruction.
 - C. All Polytech students must successfully complete a standard college prep curriculum along with technical courses and work-based learning experiences. This may require an extended school day and/or calendar.
 - i. Polytech schools must have comprehensive four-year plan and budget. School designers should lay out a four-year class schedule that should include:
 - o Four years of high school English, along with any necessary remediation.
 - o Four years of high school math, along with any necessary remediation.
 - o Four years of science.
 - o Three or four years of social science.
 - o Two years of a foreign language.
 - o Required technical courses.
 - o Any courses required by the state, such as physical or driver's education.
 - ii. Some students will arrive performing above grade level and/or will need minimum remediation. These students can be quickly put into grade level classes or even more advanced work. Any available extra class periods can be spent working on industry-related projects, advanced placement or college classes, or internships.
 - D. Decisions at Polytech schools are based on data.
 - i. Detailed student assessment is required prior to entry. The assessment must tell the educators what specific components of each subject the student needs to learn.
 - ii. Continuous assessment of student progress—ideally daily, but at least weekly—is mandatory.
 - iii. Only teachers who embrace this philosophy should be on the faculty of a Polytech school. Data is used to measure outcomes and provide real-time feedback in order to improve teaching.
 - E. Polytech schools may also include the following recommended elements:

- i. A summer program for entering freshmen, allowing students and teachers to get to know each other. During this time:
 - o In-depth student assessments can be performed.
 - o The first industry visit(s) can be made.
 - o A school culture can be built.
- ii. A school culture built from the ground up, starting with only a ninth grade class during the school's first year, and adding a new class each year.
 - o This allows the school to build its own culture and not import cultures from other schools that come with transfer students.
- iii. A relatively small number of students, allowing for greater personal attention for each student.

3. A Deep Commitment to Equity, Access, and Development for All Communities

The Polytech Model is an important component of public education in all communities ranging from the wealthiest to the poorest. It reflects a commitment to build the public education system and provide opportunities for all young people to be effective leaders in all aspects of the manufacturing economy. Re-directing our economy requires scale in rebuilding our education system and a private system is inadequate to the task. Generally, Polytech schools are non-selective schools of choice—creating opportunity for a broad range of students reflecting a broad range of competencies, aspirations, education, and skill. Our goal is a new direction in our economy, our culture, and our society focused on production and innovation.

There is a particular and deep commitment to prioritize the use of the Polytech Model in communities that have faced de-industrialization, poverty, exclusion, and marginalization. We believe that all residents must share equitably in the re-development of our economy, and enjoy access to all the career paths and resources available in our society. Only by demonstrating the relevance of manufacturing to all communities can we secure the public support for the new policies, programs, and perspectives that are essential if we are to be the global leaders in advanced manufacturing.

The Polytech Model school demonstrates its commitment to build the local community through the following elements:

- A. Linking students to career opportunities in local manufacturing companies.
- B. Opening school or local training facilities during evenings and weekends for parents and community residents.
- C. Developing close partnerships with local community colleges with robust manufacturing programs, and aggressively marketing these programs in the community.
- D. Developing close partnerships with local elementary schools and community-based organizations to expose and educate the broader community to opportunities in advanced manufacturing.

- E. Creating the opportunity for those returning to the community from prison to secure credentials and employment in manufacturing.
- F. Exploring the viability of development projects linked to manufacturing, for example in Chicago we in the process of developing cluster-based development project focused on attracting advanced manufacturing companies, spurring research and development in the advanced manufacturing sector, and providing opportunities for skills training.

Conclusion

Austin Polytech represents the first application of the CLCR Polytech Model of Education, and although still in its formative stages we have already begun to see evidence of its capacity to be a force in driving community-based economic development in the Austin neighborhood on the Westside of Chicago. Austin Polytech students and alumni are not only earning the education and skills that directly connects them to the economy but they are just starting to become aware of the positive impact their unique experiences can have on the development of the community.

This model is deeply informed by innovative best practices in education and manufacturing. However, it must be replicated, tested, and refined in communities throughout the country as well internationally and ultimately, broadly embraced and applied in order to effectively address the crisis we face in American manufacturing. We have years not decades to retool an entire public school system if we are to become a society that is economically, socially, and environmentally sustainable.

We are eager to hear your experience and perspectives.

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