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Holistic Learning in the Silicon Forest

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Abstract

Portland, Oregon has a reputation for being an “open source capital,” meaning our school aged population has some investment in figuring out what that means. Holistic approaches to mathematics, involving open source computer languages, such as Python, Ruby, other agiles, have eclipsed calculators along a newly pioneered “digital math track” in some pilot schools. We argue that geeks define an ethnicity, irrespective of race, and serving the needs of this subculture helps elucidate what “holistic” might mean, a way of connecting the dots, providing “lore”, in addition to purely technical information.

Introduction

In 2005, the Christian Science Monitor hailed Portland, Oregon as an “open source capital,” helping to spread this city’s reputation as a hub for a new kind of global economy trafficking in bits and bytes.[1] Home to the Silicon Forest, started on Hawthorne Boulevard in the city’s southeastern quadrant, Greater Portland is likewise a local headquarters for Intel, Electroscientific Instruments, Applied Materials and other hardware manufacturers, as well as for biotechnology firms, thanks to OHSU, the VA, and several other teaching hospitals, most with religious connections, most notably our Providence Health System, an early pioneer in computer intensive outcomes research.[2]

Thanks to this emerging reputation as a land of opportunity for those wishing to join the elite ranks of “geek” (aka “hacker”) teachers have been called upon to transmute this ephemeral reputation into an on the ground reality, to give students hands-on access to their heritage as Oregonians and Silicon Foresters in particular. This high level of student demand has been met with special programs designed to articulate the ethics and skills of the various hacker subspecies, and to provide holistic overview as to where these various “nations” might fit in against a wider historical and geographical backdrop.

For the last few years, our Saturday Academy, with headquarters across the street from Multnomah County Library, has worked to provide some of the relevant curriculum, including through the Hillsboro Police Department (HPD) in the vicinity of Intel. In the case of Hillsboro, students of Latino heritage were of special interest, given the demographic makeup of this former farmland. In other cases, outreach to Native Americans occurred, such as via the offices of American Friends Service Committee and the city’s human rights office.

The tribal casinos, along with Google’s data center in The Dalles, are among the heaviest consumers of IT expertise and software engineering in our region, although much of this

software is proprietary (i.e. not “open source”). For classroom teaching purposes, we consider “mathematics” as well as other academic subjects, to be “liberal arts” in the sense of “free and open” and so claim to be teaching “open source” at the K-12 level, well knowing our graduates may enter private and/or government sector silos, many of which make use of open source libraries and/or operating systems, improve on them, without divulging whatever “secret sauce” to the general public (e.g. trade secrets, other value added).

In the case of Saturday Academy, our experiments involved “Pythonic Math” where “Pythonic” means “pithy.” Results of the pilots were thoroughly documented and shared with peers. Student feedback was also solicited, as well as teacher ratings. Facilities at the Oregon Graduate Institute (OGI) and Portland State University (PSU) were used. In the case of the AFSC, we used the cable TV community access stations, the Internet, and several conferencing venues designed around the concept of “youth leadership.”

The next step in holistic integration, combining the computer programming skills with television production skills, is ongoing, with most of our output taking the form of “mathcasts” for sharing via YouTube and/or Google Video (also ShowMeDo, other venues). We are not currently budgeted to target local television and radio stations, except for the occasional recruiting commercial.

Our pilots to date have been successful enough to suggest expanding this programming to other Portland Public Schools (e.g. Cleveland), through a series of teacher trainings and more informal gatherings. Given the engineering community behind this effort is locally based, it’s relatively easy to sustain the cross-cultural dissemination of ideas by a process of osmosis involving lots of fine tuning. Sometimes we seek assistance from international experts.

Probably the most obvious example of this synergy in action would be LEP High, a public school for future leaders and entrepreneurs, and running on open source software. LEP High is run by Koreducators and implements a number of “hacker friendly” reforms.[3]

“Gnu Math” for the 21st Century

We have found that a “place based” approach is best for connecting the dots in a holistic fashion. Given the popularity of geocaching as a sport, as well as the interesting Columbia Gorge topography and terrain surrounding our metropolitan area, using geography as our entry point and front door to geometry has proved critical to our success. By keeping the information local and easily cross-checkable, we inspire students to develop a love of learning about their own locale, along with the realization that GIS databases are being amassed for their benefit. NGOs such as Ecotrust, one of our higher profile public agencies, make it easy for students to imagine themselves having careers involving mastery of geographic information systems.

The other key aspect of our mathematics track was to get rid of calculators and move to free and open source software (FOSS) running on commodity hardware. For this

purpose, a combination of Python and VPython was used, the former being a general purpose object oriented computer language, and the latter being a simple API or “wrapper” around OpenGL, a sophisticated computer graphics library. Within the first two or three hours, our students were able to start exploring with vector graphics, constructing colorful polyhedra, knowing all this software would be available, legally and for free, on their home computers as well (this proved a motivating factor, as it meant they could take their knowledge onward and not lose access to the requisite tools).

Combining a “place based approach” with technology (television and computers) has also fostered more inter-generational ties, important in traditional societies. As we move towards setting up more FOSS user groups in tribal areas, e.g. in the Warm Springs Reservation, we look forward to emphasizing this aspect of holism. The perspective of elders matters, because they have a longer view. With television comes the ability to record oral histories, and with computers comes the ability to edit raw footage and mix it with more didactic content, such as mathcasts and music videos.

The ties between geography and geometry are of course historic and well known, relate to map-making and navigation. However, “pure geometry” is not supposed to be place based (unless we count “the Platonic realm” as a neighborhood), meaning at some point our holism needs to transcend our local focus on river systems and water sheds, hydroelectric grids, zoning. All this empirical data, interesting though it may be, sometimes needs to yield the floor to purely geometrical considerations, in other words Polyhedra.

We’ve found a quasi-universal cultural pattern, which is that when you put a large monitor in front of a student and say they are going to study geometry, they expect spatial geometry. Thanks to the ubiquity of computer games, two dimensional or “plane” geometry no longer ranks as “geeky enough” and students tune out. At this point, another think tank enters our account, the Institute for Science, Engineering and Public Policy (ISEPP). Through this institution, Portlanders have secured access to several of the top thinkers in their fields, including Sir Roger Penrose of Cambridge (UK) and Louis Bucciarelli of MIT (Cambridge, MA). More recently, Dr. Susan Haack, a world expert on American Pragmatism, and Dr. Mario Livio have graced our Linus Pauling House headquarters and led us in lively discussions. These conversations with experts have helped us solve some of the mathematical challenges attendant upon getting away from the calculators and choosing a “Beyond Flatland” approach (an allusion to Abbott’s quaint classic and introduction to early 20th century dimension theory).

Although somewhat beyond the scope of this discussion to flesh out in great detail, what we developed for classroom exploration and investigation is a “geometry of lumps” based on work by mathematician Karl Menger (his daughter is one of our ISEPP members). We’ve combined his thinking with the geometry of H.S.M. Coxeter, J.H. Conway and others, to make sure we have a contemporary mix of spatial topics, most definitely including space frames such as the octet-truss (used by Alexander Graham Bell) and polyhedrally shaped ball packings (“gnomon studies”). Whereas these would be considered advanced topics in a less holistic curriculum, our students come to this

information in the course of needing to render (ray trace) precisely such geometric objects, as well as interact with them directly in a more “game engine” environment. We have used POV-Ray and VPython respectively, for render time and real time studies.

Given spatial geometry is the stuff of cartoons, our goal of uniting computer and television skills in one seamless package has been achieved, albeit not yet on a system-wide basis (a few teachers are as yet unaware of our pilots).

The Role of Engineering in Curriculum Development

Our justification for a holistic approach in the public arena traces to the democratic ideals of the Republic, which hold that any citizen has a right to seek responsible office through a vote-getting process. Effective representation requires having overview, which is what the holistic approach is all about gaining.

The American Friends Service Committee, in being a social action arm of a religious sect (“Quakers”), might at first not seem the most logical entity to be providing advanced television editing skills around international conferences. However, the Religious Society of Friends is actually well connected to Portland’s engineering culture. For example, Electroscentific Industries (ESI) was the previous owner of the Quaker meetinghouse (after Jantzen) and committed it to Quaker service on the understanding the AFSC could keep offices on the premises (it has since moved to SE Burnside, closer to LEP High).

Doug Strain, though not a Quaker, was a pacifist in the Linus Pauling tradition, the latter having received a Nobel Peace Prize for his work against nuclear proliferation in the early days of the Cold War. ISEPP is currently headquartered in Linus Pauling’s boyhood home, restored to pristine condition by the Estate of Doug Strain.

Thanks to these and many engineering ties, as well as the longstanding commitment of Quakers to excellence in education, we have had no trouble developing Portland’s Silicon Forest in ways consistent with its origins and goals. More difficult has been weaning math teachers away from electronic calculators, in favor of FOSS running on commodity hardware.

The bigger challenge, historically speaking, is any teacher with computer programming skills has instant access to higher paying careers and usually leaves the profession. We’ve needed to address this situation with “merit pay” clauses in our proposed legislation, which is fortunately consistent with Obama administration policies, which include support for charter schools such as LEP High.

Our firm belief is that Portland’s engineering culture is strong enough to bring its math track into the digital age and that the public schools will in general prove eager to embrace this heritage. The positive synergy with our local Oregon Museum of Science and Industry, with Spirit Mountain a sponsor (Grande Ronde Federation) means we have both qualified staff and ample institutional support. With ISEPP’s guidance, we’re

prepared to stay the course over the long haul, helping to anchor our bioregion to a promising high technology future involving software development, biotechnology, and Indian gaming.[4] Oregon's higher education system is adapting to accommodate these goals.

Developing New Charters for Holistic Learning

The political benefits of a place based education are clear in that our students end up knowing quite a bit about how our civic institutions operate. Given our program of invited speakers, they also know quite a bit about the various work environments available to them, if they study hard and take intelligent risks. In sum, student participation in the civic process is our chief hope for the future, in keeping our plans on track. Young people have their whole lives ahead of them, to quote a cliché, and therefore have a compelling reason to make sure their interests are well served.

To take one example of student activism, Tim Bauman, one of our Saturday Academy grads, used Facebook to spearhead a "Carrotmob" of the local Hot Lips pizza franchise. Using twitter, IRC, text messaging, a large turnout of young people was promised, in exchange for the retailer committing to various socially responsible investments these profits might support. In the case of the June 21st event (Father's Day), the goal was to raise the \$6000 needed for some solar panels.[5] Similar community organizing took place among students at LEP High where Portland Public briefly threatened this charter with closure, buckling under union pressure. By means of television and music, the students fought back and were able to secure additional public support for their academy.

The tribal authorities have similar challenges in that Native American populations would like to nurse a next generation of future leader, one comfortable with high technology and in no way "second banana" compared to more privileged counterparts of Euro and/or Anglo heritage. Thanks to FOSS and the low barriers to entry, holistic education is in principle accessible within the tribal context. Given Quakers have a multi-generation history of working with original peoples (or pueblo), we have something to build on.

In sum, student organizers have a lot of responsibility for keeping holistic education alive in the Greater Portland area. Because the curriculum fosters place based awareness and media skills, including website development, our recruitment drive and trainings get top notch assistance. ISEPP was recently joined by a "cyborg anthropologist" Amber Case who is helping with ideas for how to develop these natural synergies even further.

Conclusion

Portland is interested in keeping its reputation as a FOSS capital and is using a place based curriculum to answer student demands for a "geek Hogwarts" experience.

Developing in this direction has meant severing ties with some of the more traditional textbook approaches, as our students tend to regard wood pulp textbooks as holdovers from a prehistoric dark ages. Oregon is quite sensitive about lumber and wood issues, and whereas we naturally accept that these raw materials have an important role in our economy, we don't like to see them wasted. Electronic media have replaced print media

in many of our classrooms. Fortunately, publishers such as O'Reilly already offer their books in PDF, so our cost savings have already been substantial in this regard.[6]

Clearly we have a long way to go, now that our pilot studies have been completed. Plans for various Python conferences for math teachers, perhaps in tribal resort casinos (e.g. Kah Nee Tah) are in storyboard form at the moment. Not every public school teacher is eager to embrace drastic alterations in their daily routine, so we're moving forward with recruiting by a process of self selection. We only need a few elite schools to offer holistic education, to give a sense of what it's about. Imitators will spring up in proportion to our perceived level of success, at which point quality control will become more of an issue (so far, we're too small of an enterprise to worry about imitators).

The focus in phase two is teacher training rather than direct instruction of teenagers, as now that we have proof of concept, economies of scale are such that teacher training will be the most efficacious way of spreading this approach. We expect to continue using some of the new charter school legislation to our advantage, plus have developed collaborative relationships with counterparts in Alaska, another state eyeing our progress and thinking about following suit.

Endnotes

[1] Elizabeth Armstrong Moore. *Oregon city builds a reputation as a hub for software revolution*. Christian Science Monitor, November 28, 2005.

[2] the Center for Outcomes Research and Education (CORE), an entity within the Providence Health System, helped spearhead some of the technologies now used to assess hospital health more generally.

[3] koreducators.org

[4] the nature of Indian gaming is not entirely fixed by statute, but will remain software and database intensive, another source of career opportunities. The State of Oregon uses similar gear in its certified lottery games, though these tend to be of older vintage than what's available to casino customers.

[5] <http://coffeeshopsnet.blogspot.com/2009/06/carrotmob-helps-merchants.html>

[6] The Litvins' text, *Mathematics for the Digital Age and Programming in Python* is available in PDF from the publisher, Skylight Publishing, as is another favorite, *Hello World! Computer Programming for Kids and Other Beginners* by Warren D. Sande and Carter Sande, by Manning Publications, Co.

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