Teaching, Learning, Technology – What will it look like at PCC in 2020?

A Faculty White Paper

Spring 2006

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Executive Summary

The purpose of this paper is to explore the future of teaching and learning at Portland Community College and develop a snapshot of what PCC might look like 10-15 years from now. The formal research question posed by Dr. Chris Chairsell, Vice President, Academic and Student Affairs, is; "What should teaching, learning, and technology look like in the future?" The premise for this study is that technology initiatives at PCC must be driven intentionally by the teaching and learning initiatives of the institution. Technology planning processes must reflect the academic needs and demands of the college over the next 10 years (Barb Vanamerongen and Deans of Instruction, February 21, 2006).

A three-member faculty-led team headed this spring term investigation with the assigned task of producing a Faculty White Paper. Research methods for this study included a multi-faceted approach of framing questions for conversations with faculty members and administrators, interviews with assorted Portland Community College special task groups, discussions and observations from other higher education institutions—most of whom attended an EDUCAUSE Conference with the team members, student and faculty surveys, campus-wide Forums, and extensive literature reviews.

This white paper presents findings that summarize and answer the above research question, conclusions and how they apply, plus recommendations and implications. The study has three areas of focus; learning and teaching, technology, and learning spaces.

The most important factor in **learning and teaching** is effective learner-centered pedagog***y*** that helps students learn and achieve their goals. Effective pedagogy is based on demonstrated best practices and emerging research on adult learning. It is found that research generates new understanding at a moderate pace, while implementation is often considerably slower. The challenge for PCC is to be aware of new research and to work to implement best practices.

In spite of the fact that **technology** changes very rapidly, many of the tools that we will use at PCC in 2020 already exist. Some are being developed in research labs and being discussed in journals and at conferences, some are newly emerging from the labs, and some are already being implemented at a small number of universities. The challenge for PCC is to become aware of emerging technologies and have a strategy for identifying and adopting those technologies that will prove productive in supporting and enhancing learning in our environment.

The spaces where learning takes place are changing in important ways, as are expectations of what a good **learning space** should look like and what it should provide. PCC faces the challenge of finding ways to adapt existing buildings to new paradigms of learning, and designing new buildings that will provide good learning spaces far into the future. Indeed, as the relationship of teaching, learning, and technology evolve, all spaces will have the potential for becoming learning spaces, either physical or virtual.

Three themes have emerged from research and interviews that further enhance understanding in these focus areas: The need for flexibility, student access, and adoption of new pedagogies and technologies. Flexibility is the ability to respond in a meaningful and timely manner to our student needs. Access is the ability for students to easily enter and communicate in the contexts of social, academic, and administrative activities. Adoption is a process of awareness, experimentation, adaptation, and implementation.

Technologies that support the educative process should be both effective and transparent to the degree that learning to use the technology does not inhibit the process of learning the content. Further, any changes in practice and technology should result in substantive improvement in the areas of critical thinking, communication, and collaboration—three competencies most highly valued by employers.

Teaching and Learning

Flexibility

> *It is the year 2010. Joanne S. is a lower-division transfer student attending classes at Portland Community College. Having recently completed high school, Joanne chose PCC to further her education. Her plan is to complete her lower-division collegiate requirements at PCC, then transfer to a 4-year institution through a co-enrollment program. What follows is a typical morning in the life of Joanne.*

Traditional college freshmen students in the year 2020 are today's kids, born around 1997. They have grown up in a world packed with information and entertainment. Many, if not most, Net Generation students have never known a world without computers, the World Wide Web, highly interactive video games, and cellular phones. For a significant number, instant messaging has surpassed the telephone and electronic mail as the primary form of communications (Roberts, 2004, ¶. 1). Furthermore, today's Net Generation student will often be found multitasking and talking and emailing at the same time, while still surfing the Web and watching television. This illustrates how today's learner is active and accessing multiple streams of information all at once. It also shows a climate in which the learner, as a consumer, creates significant demand-pull for certain tools and technologies. We have already seen this at PCC. The introduction of MyPCC was largely driven by student interest. Cascade's Technology Education Building features wireless nodes provided in response to students' needs for wireless connections in the common areas. Similarly, student demand drove the installation of Open Office (an open-source productivity suite similar to Microsoft Office) in the Cascade CRC. (Keith Furrow, personal interview, May 19, 2006)

> *8:00 AM: Joanne begins yet another busy day. As she munches on a bagel and tosses down some extremely strong Italian roast, Joanne logs on to check her email and catch up on work that her collaboration partners may have completed overnight. She's extremely pleased that the City of Portland decided to initiate the construction of a citywide wireless cloud. Joanne surfs free of charge, ignoring the 1-inch banner ad that doesn't really impair her experience. She is able to check email, WebCT, catch up on the wiki her collaboration partners are using for their cooperative project in Psych 201, and IM (instant messenger) her study buddy from History class about an upcoming service learning project.*

Millenials, the Net-Generation, Echo Boomers, and other descriptors represent these individuals who don't think of technology as something novel, but take for granted that this is the way things are done. The Net Gen student has developed a greater digital literacy than those even just a few years older (Oblinger & Oblinger, 2005, p. 2.1). When fully realized, this is the ability to show proficiency in science, technology, and culture, as well as gain a thorough understanding of information in all its forms (International ICT Literacy Panel, 2002). Digital literacy also means the ability to access information from an array of sources and in multiple formats (e.g., audio, video, text).

Net Gen students have seemingly always lived with some degree of connectivity to the Internet and view 24/7 access as virtually a birthright. This describes the new paradigm, now past "emerging," and is today fully engaging students at our community college. Significantly, the typical student at PCC is not in the youngest age group. Nevertheless, active learners are finding that the technologies that we have currently often suit them well and give them a degree of choice unmatched in past years. It is increasingly common to see students of all ages using PDAs and computers, not just because they are required or even "hip", but because they offer significant advantages that help them cope more effectively with the responsibilities of completing an education.

> *Even though she is short on time, Joanne is comforted by the fact that she will be able to connect wirelessly once on the #72 TriMet as she heads for Cascade. While laptops have become considerably less expensive, Joanne likes to use her WiFi-enabled smart phone to connect while on the TriMet system. This has allowed her to contact faculty and fellow students during times that would otherwise be wasted. She can also access WebCT and Web-based references available though the regional library consortium, but the screen is a bit small for this sort of work. Joanne will use the lab in the Cascade library to conduct her research, then choose between saving the needed files to her smart phone or storing them on her personal storage device. Time to run for the bus!*

Students expect flexibility when it comes to learning options, and this is often driven by the competing demands on their limited time. New technologies will allow for this flexibility in providing more choices, and a shift to a new pedagogy will result in higher levels of learner and educator satisfaction. Indeed, the advent of new teaching techniques and the technologies to apply them is already leading to the ability to tailor learning to individual needs and learning

styles while providing the agility and flexibility for students to access content and complete class requirements using an ever-widening array of learning methods.

Research has shown that educational best practices such as collaborative group work, expeditionary learning, and service learning pay huge dividends because they contribute significantly to the meaning a student can invest in a subject (relevance), and these practices also help to develop skills that society highly prizes in those who work and live within it: critical thinking, the ability to communicate effectively, and the ability to work in groups (collaborate) successfully. Not surprisingly, the learning environment will increasingly feature opportunities for students to work together in authentic learning experiences that may take place outside of traditional college venues. In effect, the world becomes a classroom, and learning can take place anywhere.

> *8:15 AM: Comfortably seated on the #72, Joanne retrieves a message from her history partner and then connects wirelessly with her math instructor. They agree upon a time to meet later that day at Sylvania. Joanne signs off and turns to her class notes from Psych 201. As she rides to campus, Joanne is able to review the Power Point slides from the last four lectures on her smart phone. In order to deepen the learning experience for the students, Joanne's instructor Podcasts the lectures. Students may download the audio lecture as soon as 20 minutes after the class ends. They can then listen to the lecture AND review the slides as many times as they like. This works well, as Joanne knows she's not an auditory learner and must compensate by using her other learning styles. Armed with this combination, she'll be ready to tackle her online mid-term in just a few days.*

Access

Learning is social, and learning within a social organization requires communication and collaboration skills supported by the ability to critically think across philosophical differences. Shifts in ethnicity and population segments will reshape the look and feel of teaching and learning in the future at PCC. Richard Byrne, in an article published in The Chronicle of Higher Education, states, "that the face of higher education will change greatly over the next decade in favor of more diversity" (2005, p1). He supports this by defining diversity as the new wave in numbers of Hispanic students who are predicted in the college-admission pool to be more than ½ half million. This compares with 350,000 black and non-Hispanic graduates.

This shift has implications for access to learning and how PCC responds to this trend. One implication is the importance of facilitating collaboration and learning in diverse face-to-face cohort groups. Another implication is the role that PCC must play in providing equal access to technology. Regardless, whether or not students have access to computers and the Internet from home, they consider such access important (Oblinger & Oblinger, 2005, p.2.3). However, one note to consider is that home access to computers is nearly 20 percentage points less for blacks and Hispanics, than for whites. In addition, income creates about a 20-point increase in Internet access for those households above $50,000 per year.[1]

Adoption

Adoption can be described as a process of awareness, experimentation, adaptation, and implementation. With regards to teaching and learning, the focus is on identifying and implementing best practices that will improve student performance and increase the chances for student success.

> *9:30 AM: The history instructor has just completed what he calls his "20 minute dog-and-pony show." He offers direct instruction through lecture on a specific topic during each class period. The lecture is supplemented by Power Point slides and simulations developed in cooperation with experts in Distance Learning and highly able students in multimedia. The lecture itself is digitally recorded and "pushed" to a Podcasting server. The students can download all of this content for review right after the class is over. Many students save the files to their laptops, desktop computers, portable memory devices, mp3 devices (think iPod) or smart phones and begin their reviews immediately. The class meets face to face only once every two weeks, so the students are anxious to see both their peers and their instructor.*

Traditionally, the delivery mode of choice in the typical college classroom has been direct instruction. Instructors working in this mode rely primarily on lecture, sometimes supplementing their comments with annotations on a chalkboard, white board, or by way of

[1] Clearly, nontraditional and work-force development students are a growing part of the educational program at Portland Community College. Unique learning requirements must be addressed in order to meet these needs. At stake is a large sector of the student population who, if they are not able to obtain education and training needs at PCC, will find another public institution that does, or seek out a private and for-profit provider of such services. The competition of private training and education providers is a major factor when planning for the future.

simple Power Point slides. Communication is usually one-way. Students listen, take notes, and leave. This has been a standard for decades, but experience, common sense, and research indicate that this may not be the best way to deliver instruction to all students. Indeed, since an estimated 30% of a given population (as low as 12% for younger students) learns best in an auditory mode, the balance of the class is left to make the best of the situation, sometimes struggling to take in the presentation material while simultaneously attempting to understand the content. (Liu and Ginther, 1999, n.p.)

It is also important to remember that a significant (and growing) portion of any student population may face learning disabilities and second language barriers that exacerbate any difficulty faced with the content itself. (Heiman and Precel, 2003, p. 248) Clearly, adopting and adapting pedagogies that increase learner efficiency is not only a noble goal, but also a necessary one if PCC is to maximize learner satisfaction. In so doing, it will also increase student retention and completion rates and in the end create a population of learners who will become "students for life." The role of the educator is shifting to one that blends direct instruction with facilitation and collaboration. Authentic learning situations require that students have the opportunity to work within a field and experience the discipline as completely as possible.

> *After the 20-minute lecture, the students are to work collaboratively on their hands-on history project. Joanne's group is helping to map the brief history of Vanport in cooperation with a local community group. Students reorganize the easily movable furniture to create workable collaboration spaces. Some groups head for the library or the student center, where they work cooperatively on innovative computer workstations that allow them to share control of the input via multiple keyboards and mice. Other student groups agree to meet online later by way of the collaboration tools that are built in to WebCT. Class may be over, but the learning certainly hasn't stopped.*

Awareness

The prospect of a new pedagogy is an exciting one. In order to learn about best practices in the field of adult education, it is essential to look both inside and outside of the institution. Inside, there are key individuals who are working in creative ways to increase excitement and learning. These innovators often go unnoticed by the majority of the college community, and they are often content to practice their craft to educate and inspire their students. The traditional organizational format of education is partially to blame. Housed in separate "silos," education

professionals find themselves communicating only with other professionals in the same discipline, if they communicate at all. Departments and individuals who may be creating new and innovative content and practices are known only to themselves. Developing simple, yet effective programs to encourage and help educators to purposefully collaborate and learn from one another would encourage a sort of "cross-pollination" of ideas. Ideally, education professionals would use the innovators as a *reference group*, as individuals of similar backgrounds and common interests tend to trust the experience of peers more than external authorities when evaluating the educational validity of novel approaches. Professional development opportunities that help educators adopt and adapt current best practices are vital, and providing a more formal system of mentorship would drive collaboration. A key to this would be some sort of recognition program that would appropriately showcase innovative practices and partnerships.

> *11:15 AM: Joanne sits on a bench with a peer just outside of the Technology Education Building. Because wireless coverage extends to this public place, Joanne's friend can access the Web from her laptop. Together, the two students securely engage in online research that would have required a trip to a physical library only a few years earlier. Time to shuttle to Sylvania!*

Outside of the institution, there is significant experimentation and innovation in evolving pedagogies. The professional literature is peppered with analyses, synthesis papers, and applications research discussing new and innovative approaches to teaching and learning. It is very important that any institutional initiative include support for site visits and collaboration/cooperation among different institutions. The benefits go far beyond awareness of new programs. The value of inter-institutional contact and collaboration can be great (Greg Malone, personal interview, May 11, 2006).

Scott Gibson, Vice Chairman of the Oregon Health Sciences University (OHSU), and major funding source for the new Babson College/Willamette University MBA program partnership, suggests that Portland Community College could play a key leadership role for a state-wide partnership whereby all 17 Oregon community colleges benefit substantially by sharing certain infrastructure assets and resources (Scott Gibson, personal interview, May 1, 2006). This leads to discussions about how sharing people and program assets across these multiple community colleges could synergize and deliver powerful learning solutions.

Experimentation

The use of pilot studies and experimental groups is vital in assessing any new approach. So it is when considering a pedagogy shift and its impact on teaching and learning. While innovators tend to experiment freely, many who would benefit from a new approach are less likely to try new approaches. What if it doesn't work? What will the students think? What will the administration think? It is vital to establish and maintain a climate that encourages thoughtful, systematic experimentation with emerging pedagogies and technologies. This system should provide ample support to and recognition of initiatives designed to increase student satisfaction and success. It should be difficult for education professionals NOT to know what is going on in their institution in terms of best practices and innovation.

Adaptation

Every institution is different. Successful programs choose technologies that are readily accessible to learners and educators while supporting the educative process. When asked why his program does not favor mainstream use of "…extremely exotic, terribly high end technologies…" in his teaching at Harvard University, teaching and learning scholar Chris Dede explains, "…there would be no point. What would students do when they left and couldn't use any of the technologies that we had experienced together in class?" (Grush, 2006, p. 14). Similarly, infrastructure modifications that work well in residential colleges may not be as successful in commuter colleges, institutions that traditionally have transient student populations and no residence halls, such as PCC.

> *Upon arriving at Sylvania, Joanne gets a quick lunch and prepares for the afternoon. She has a wide variety of tools to support her. After the lecture in math class, Joanne will be able to access Web-based learning objects during the discussion and collaboration phase of this class. She can bring her own laptop, check one out from the library, or use the Computer Resource Center. The comfortable, colorful common areas located around the campus are really collaboration centers in disguise. They are fully supported with abundant AC power and wireless connectivity. Some even feature ASPCC-run mobile espresso carts, complete with a tasty selection of comestibles to refuel the weary student. PCC has also found a way to make some spaces safe and available for up to 24 hours per day. This supports the students who may need access to certain tools, or who may simply need to get out of the house to get some studying done.*

The process of adapting new approaches to pedagogy is informed by awareness and experimentation. Understanding what is possible and systematically testing emerging education practices in the context of the college will yield a wealth of information that will be indicative of the degree of success likely for a particular technique. Experimentation allows education professionals to assess tools and techniques, while the adaptation process supports continuous improvement within the college by encouraging individuals and departments to fine-tune the manner in which a particular innovation works. Ultimately, it should be possible to choose among the best-of-breed pedagogical approaches and tailor a solution that will work with the unique student profile in a particular college, division, or department. While this shouldn't be done on a grand scale until the possible benefits and costs are identified, it is important that this work occur in a visible place and in an atmosphere that supports innovation.

Implementation

Research has shown that effective learning activities are learner-centered, social, and active. In a learner-centered system, learners take greater responsibility for their learning and are more likely to take risks. With the educator assuming a blended role that includes instructional leader, collaborator, and facilitator, learning takes on a much more social and active approach.

One of the key values in implementing such programs is that the learner has a much better context in which to make sense of the content. This is why professional/technical programs engage students in the actual work to be done in a particular discipline. Nursing, fire science, and criminal justice are good examples of programs that leverage the potent combination of theory and real-world practice. This encourages not simply knowledge and comprehension, but more critically the ability to analyze situations, synthesize solutions, apply those solutions, and then critically evaluate the efficacy of the analysis and application. This sort of critical thinking is both prized by employers and necessary for long-term student success.

> *Distance Learning options have proliferated in recent years. Most classes are offered at least one a year via distance, and a comprehensive mentorship and cooperation program has made it possible for faculty to add online content to their courses without having to learn everything about the underlying technologies. This effort has had the side benefit of bringing departments together in ways never seen before. Instructors are also gaining a new appreciation for the expertise of the DL, instructional design, and library/media folks throughout the region. PCC now participates in a semi-annual technology integration fair and workshop that*

involves educators from K-12, community colleges, and 4-year institutions.

Successful implementation of leading-edge pedagogies will increasingly feature opportunities for students to work together in authentic learning experiences that may take place outside of traditional college venues. The introduction of more blended and hybrid courses, active experimentation, and group/team learning will lead to increased levels of critical thinking.

Recognizing that current and future students expect learning to be increasingly independent of both time and space, the goal of the college will be to provide access to learning in both actual and virtual spaces. Further, there will be increasing pressure from students to deliver instruction in time periods best suited for those students. Distance education is here to stay; there will be increasing demand to deliver educational content in a manner that can be accessed remotely, thus making education something that students "do" within the community, not just within a classroom or lab environment.

Making this work requires that students learn how to be successful in the new learning paradigm. Technology-mediated learning and a move to a more learner-centered approach will require psychological preparation (i.e., accepting responsibility for learning, understanding learning processes, metacognition) and learner training (i.e., developing study habits and learning to use tools/technologies). For educators, the evolution of collaboration models and rich, diverse teaching and learning techniques will demand mechanisms that provide modeling and training in the new pedagogy, as well as an effective support system that increases educator success with new educational approaches.

Technology

Flexibility

Students will expect more flexibility when it comes to learning options. The adoption of new technologies will allow for this flexibility in providing more choices and even tailoring learning to individual needs. Learning technology will embrace many and multiple modalities of learning and pedagogy. Bandwidth and connectivity will no longer be barriers. It will be easy to record almost every aspect of classroom interaction: video, audio, white board, student notes, etc. Archives of classroom information and interaction will be automatically and immediately accessible online and linked to each students class web page (e.g., WebCT, Moodle, Sakai, etc.). It allows for different types of data input, output—but most importantly—production. Voice,

video and text data converge; students take content from other people to mix it in creative ways in order to produce, publish and distribute it (Hilton, 2006). This unbundling capability is relevant to PCC's future technology strategy when considering hardware, software, and various information management systems.

Technology investment is a must. Requirements include robust and scaleable enterprise-wide learning and support management systems. PCC-owned learning technology assets provide powerful back-end support of computing needs for network access, storage, computation, and *presentation* requirements. The focus is on learning, and this technology quietly supports behind the scenes social connectivity as students collaborate, communicate and construct contextualized meaning.

> *The move to collaborate has meant that faculty are using a variety of technologies and pedagogical approaches to help students learn. While the lecture will probably never be replaced, there is a drive to inject more active learning into the process that will increase the students' abilities to think critically and communicate effectively. By instituting uniform and educationally valid policies and guidelines concerning writing, communication, and assessment/evaluation, PCC presents the same set of requirements to all students, online or face-to-face. By engaging in a collegial approach to integrating these ideas, the College has both garnered the acceptance of these policies and captivated the enthusiasm of the faculty who feel that these policies work and are good for students.*

A key role for technology is to assist in managing the learning process. Commercial learning management systems (LMS's), such as WebCT, are designed to make it easy for faculty members to create a course web site and organize course materials, automate and orchestrate the presentation, process content between instructor and student, as well as provide certain assessment capabilities.

However, the 21st Century Net Gen student requires more flexibility than ever before. This requires tools that can search and acquire information from the broadest possible array of data sources, interact and collaborate digitally, use and reuse learning objects, stay current with fresh and up-to-the minute data feeds, and many other technology-enabled features that support the learning process from information acquisition to knowledge construction. The system, or constellation of systems, must support learning demands from entry to exit points, whether it is through a scaleable LMS, proprietary business management systems, or integrated and

enterprise-wide systems and infrastructures. A single, enterprise-wide, technology management system is fast giving ground to more flexible and robust web-based solutions that allow for scaleable provisioning of student and instructor learning needs.

A corresponding requirement is that learners and educators acquire and develop new skills with regard to improving information literacy. Indeed, the vast amount of information made available through gains in information technology will mean little if those engaged in education do not have the tools essential for finding, evaluating, and effectively applying it. (Anderson, Kessinger, Shapiro, email communication, May 31, 2006).

Vended software packages usually results in the design of a "one size fits all" approach to application development. Such propriety products lack the flexibility vital to adapt to the unique needs of a PCC student, or of an innovative instructor. Open source software, sometimes developed through collaboration with other educational institutions, is an example of how some schools have increased their potential for flexibility. This would include everything from customized distributions of operating systems such as Linux to learning objects developed in Java™, Flash™, and XML/XHTML. The idea of reusable learning objects is incredibly attractive from the standpoints of efficiency and cost containment.

Access

In addition to flexibility, access to technology is required. PCC will offer anytime, anywhere access to all types of information that is essential to helping learner, instructor, and administrator achieve institutional goals. Ubiquitous access to information is inevitable and necessary. Knowledge construction now occurs non-stop (Hilton, 2006). While such access can be disruptive to older models of classroom instruction, it is an important component of the emerging learning paradigm.

Dr. R.H. Bamberger from Microsoft aptly describes a fundamental characteristic of learning as "connected learning" (2004). This represents a well-designed and functional access model that supports multiple connectivity through a combination of technology, learning, and administrative support.

The following diagram depicts this model showing a hierarchy of emergence into a top level of a fully integrated and always connected mode of learning, from an earlier stage of traditional classroom and lecture-based pedagogy. As you can see, there is a progression and most institutions today are somewhere between the lower and middle levels.

Model for Education Evolution

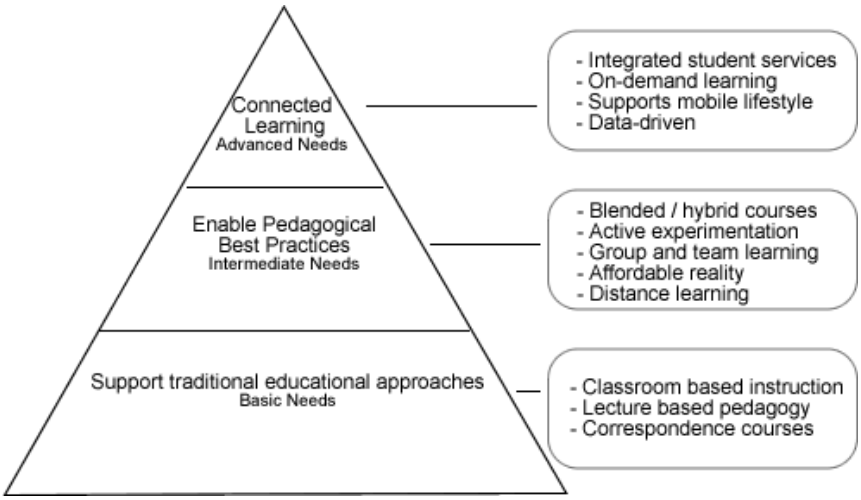

Figure 1. Bamberger: Learning in a Connected World [source:http://www.microsoft/education/]

Connectivity in the technological sense provides access locally and remotely through a combination of wireless and wired forms. Learning connections provide students access by which they locate course information, collaborate and construct new knowledge products, communicate peer-to-peer and peer-to-device, and research. Finally, administrative connectivity provides student support services to manage course registration, financial aid, and special programs, to name just a few

Bamberger continues in offering a conceptual model of learning and addresses the evolution of moving a learning organization from a basic-level of classroom/lecture-based pedagogy, to one fully engaging learner-centered/on-demand/mobile/data-driven/and personalized “connected-learning” (2004, p. 5).

Most colleges today operate at the base level in this hierarchy and, to some extent, leverage technology to support traditional and basic models of education. Usually at best, they use commercial content/learning management systems (e.g., WebCT, Blackboard) to port classroom content over to online delivery.

The next step finds innovative educators raising the bar and enabling pedagogical best practices. Examples include learning situations in which students are enabled to participate through active experimentation, some classroom activities are replaced with online “seat time”, while some course content is broadcast to students online allowing for more effective face-to-face activities, and small group collaboration is facilitated through the use of authentic, real-

world activities that give project teams the opportunity to tackle real problems. The learning can be mediated by technology, as is the case in simulations in allied health and aviation. It can also be leveraged by technology, as would be the case when students use tools such as digital video, Podcasts, and Wikis to communicate about their learning.

Leading-edge institutions have a vision for connected learning, embracing the challenges of the education and training needs of the 21st century. An exemplary college environment of "learning to learn" prevails among students, faculty, and administrators. They have thoughtfully and strategically replaced out-dated conventional practices with student-centered teaching and learning. Student services are fully integrated throughout the education enterprise, access is provisioned "on-demand", and learning events are often personalized and data-driven. These factors begin to offer the new millennial student learning on-the-go, just in time, and "just for me."

A further innovation that has great merit requires users to cut the cable and go mobile. Wireless is a very attractive connectivity solution for the future. Students are using wireless and ignoring the presence of hard-wired connections in current PCC learning spaces. (Bill Phillips, personal interview, May 22, 2006) The proliferation of compact, increasingly affordable, personal electronic devices (e.g., smart phones, iPods, PDA's) that can handle educational content means that students can receive assignments, communicate with instructors and peers, and access reference materials from literally anywhere.

The Portland-based Personal Telco Project [http://www.personaltelco.net] currently offers more than 100 wireless "hot spots" in coffee shops, small restaurants, and public spaces throughout the urban area. The proposed metropolitan wireless initiative is destined to make wireless even more widely available. As an anchor partner, TriMet will be affiliated with this venture, and, if all goes according to plan, the mass transit concern may soon be offering wireless connectivity on buses, trains, and transit platforms. (Lisa Yeo, personal interview, May 9, 2006). The net result is that students could be more effectively and continuously connected, and at a lower cost (the free connectivity carries banner advertising; ad-free connectivity is estimated to cost around $20 per month) than is current possible with wired alternatives. (Rogoway, 2006) Affordability is significant in PCC's demographic and is evident by the fact that a number of students are still using dial-up connectivity, an alternative that doesn't always

mesh well with bandwidth intensive applications such as WebCT (Linda Bruss, Verna Reardon, personal interview, May 19, 2006).

Access is such a powerful factor that it will “tip” any technology leveraged by it. . Any successful system must be readily accessible from locations on and off campus in order to be of use to students and educators. Students have a growing interest in distance education, with many of them taking classes online even though they live within 10 miles of a campus. Those who don't have access will travel to get it (i.e., using the CRC, Multnomah County Library, a friend's Internet connection, etc.). Students indicate that it is not the college enterprise that drives them to do this, but the realization that the information they crave can be found more easily and more quickly by accessing a broader network.

Adoption

The optimum time for adopting emerging learning technologies is an issue worth considering. The Gartner Hype Cycle describes the lifecycle of emerging technology. Visibility and expectations run high at first, but it takes time for a technology to mature and settle into real-world productivity. PCC needs a measured approach to adoption, including realistic

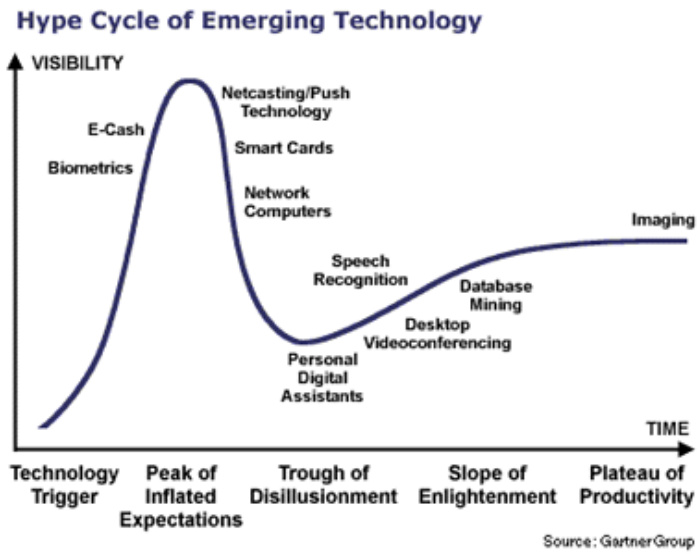

Figure 2. The Gartner Hype Cycle [source: http://www.floor.nl/ebiz/gartnerhypecycle.htm]

strategies for researching emerging technology, encouraging experimental implementation by early adopters, and scaled adoption as benefits are demonstrated. This smoothes the hype curve and better assures a positive and sustainable return on investment. Crowder of Nobelstar (2004) suggests this approach for business, but a similar model can be applied to education at PCC. This

will require a carefully constructed approach that will involve educators and learners who feel comfortable with the technologies acting as mentors and reference groups for those who are less than comfortable with technology change. When well executed, a “good” return on investment for PCC will be in the form of smooth integration of technology and successful experiences for educators and learners.

Based on the writings of Geoffrey Moore in his groundbreaking book, Crossing the Chasm (Moore, 2002), those who adopt the technology will come from different levels of comfort in proportions to the total population based loosely on a Bell curve distribution (see figure 3, below). The learners and educators who possess the newest toys first are the innovators. At PCC, innovators drive awareness of new tools and technologies that could possibly be applied to education in some way. The early adopters come along somewhat later when a practical use has been found (intentionally or accidentally) for the new toys. At PCC, the early adopters take emerging technology and experiment with it to find educationally-valid applications. Next, they adapt it to promising learning contexts within the College. It is they who will act as the mentors, collaborators, and early exemplars of practical applications. Their efforts will help span the gap between themselves and the early majority. This will lead to successful implementation and integration of the technology.

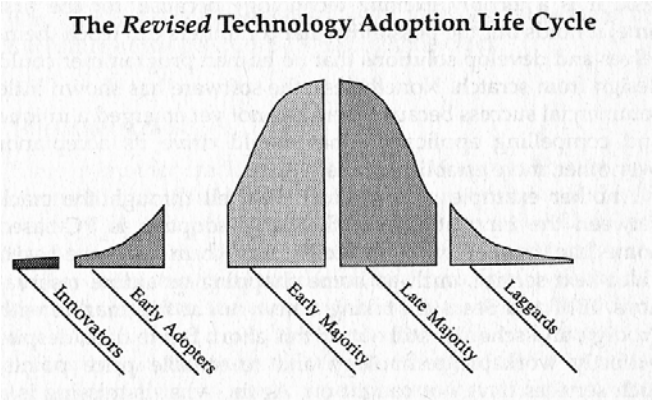

Figure 3. Moore's Adoption Life Cycle [source: Moore, 2002, p. 17]

We should not assume most PCC students own or have access to cutting-edge mobile devices off campus, even in 2020. PCC will continue to provide access to hardware on campus, in addition to finding ways to make mobile devices available to students who need them off campus (e.g., library checkout of laptops or iPods; cost discounts leveraged by PCC; pay-per-use

programs, etc.). Curriculum, instructional design, and software and hardware systems should all work cohesively so that students can engage in the appropriate and desired learning activities from a variety of devices and times and places that optimize their learning experience.

In order to ensure that learners and educators use the resources to their utmost, it is imperative that significant time and resources be devoted to helping educators successfully and effectively use existing and emerging technologies to leverage learning. This means in-service training, mentoring opportunities, visionary pilot projects, and support for design and production. An example of design and production might be an animation that shows a biology lab process, such as frog dissection [see http://www.froguts.com for an example of the type of animation that could be developed]. Teaching an instructor how to effectively integrate this animation into curriculum may also require mentoring. Such efforts help highlight the technologies available today as well as those emerging tools and ideas that will support PCC in the future.

A key element here is increasing substantive communication about learning within and between departments and campuses, and even between PCC and other education enterprises in the region. This may require that those who are comfortably accustomed to traditional direct instruction methods be supported as they diversify their pedagogy. Many experts in the field of educational technology feel that educator involvement is one of the most difficult goals to achieve. As a culture, PCC should carefully assess the concerns of educators who are reluctant to adopt technology and use those observations when designing projects to help them be successful. In the words of one expert, "…those most resistant, fearful, or reluctant may best define the undertaking" (Starrett, 2006, p. 58). PCC is a learned community; we also should be a learning community.

Ease of use is also a factor to consider when adopting and implementing specific technologies. Apart from the initial training and learning curve required by new technology, the day-to-day time requirement is a weighty factor for faculty as they consider adopting new technologies. On the whole, there is less concern for many of the students—they've already found the "new thing". Now it is time for the educator/facilitators to catch up with them.

Learning Spaces

Flexibility

Students expect learning to be independent of both time and space. This, of course, demands environments that support learning while utilizing both physical and virtual spaces.

Flexibility is required in both new constructions as well as in existing buildings. An example is to consider remodeling a conventional classroom into a newly designed space, one that accommodates a variety of learning activities. Cyprien Lomas, an EDUCAUSE Learning Initiative (ELI) scholar, states that physical learning spaces should be designed around what people do, not square footage. They should be adaptable with the ability to transform a given physical space with a quick turnaround time (EDUCAUSE Conference, pre-conference seminar, April 24, 2006). Learners and educators are already reconfiguring spaces as much as possible to fit the room/space to their needs by moving furniture (Bill Phillips, personal interview, May 22, 2006), thus indicating that current structures and their configurations may work if a more flexible approach is assumed concerning the way buildings are used.

In addition, open and flexible spaces emphasize leveraging informal spaces for learning; some on-the-fly and ad-hoc learning episodes occur as learners pass through from one location to another. An example of this would be a student moving from a formal classroom session to the public commons area where a group of students informally meet in spaces to collaborate. This phenomenon can be seen in areas such as the College Center (CC) at Sylvania and the open commons in the Cascade Technology Education Building (TEB). Sylvanians move available folding chairs and tables in the CC to form ad hoc collaboration spaces. Cascadians use the TEB space frequently and throughout the day. This area is especially favored now that there is wireless available throughout the TEB.

Agility then describes another iteration of flexibility and might best be described as having the capability to change quickly and easily. Again, back to physical learning spaces; a classroom should have the capabilities of being made suitable for a new set of learning activities within moments, and with minimum effort. An instructor may wish to quickly convert a lecture session into a small group collaboration event. That requires the quick adaptation of people, tables, chairs, perhaps visual overheads, etc. Good examples of flexible and agile learning spaces include the following:

- Stanford's Wallenberg Hall [http://www.wgin.org/projects/wallenberg_hall/]

- University of Waterloo's LT3/Library Flex Lab [http://lt3.uwaterloo.ca/FLEX]
- MIT's iCampus Teal (Teaching Enabled Active Learning) [http://www-caes.mit.edu/research/teal/index.html].

Oblinger and Oblinger's analysis of learning spaces predicts that learning spaces of the 21st century become more than just physical locations (2005, pp. 12.1 to 12.22). Virtual spaces become as much a part of how students access information and construct new knowledge as are physical spaces. Further, they discuss the implications for investments in technology and people. The matrix below illustrates location and physical structures used in today's learning compared with those of the future (2005, pp. 15.15 to 15.17).

Table 1. Speculations About Higher Education Now and in the Future

Dimension	Now	Future
Location and physical infrastructure	Locations and physical infrastructures configured to accomplish specialized forms of activity (such as dorm room or apartment, classrooms, student center, library, computer lab) Direct physical manipulation of equipment in science lab	Wearable devices and universal wireless coverage mean access, information, computational power no longer tied to physical space (such as a computer lab) Most activities distributed across space and time, so tailoring space to particular purposes (such as library reading rooms) often no longer necessary The notion of place is re-purposed and becomes layered, blended, and multiple. Mobility and the tendency of a student or group of learners to move about rather frequently. Examples found in learning settings that are dispersed, fragmented, and with fluctuating habitats—see coffeehouses near campus. Virtual simulations complement equipment-based science labs

The above characteristics serve as clear indicators that the emergence of neo-millennial learning styles will influence higher education and how it views investment in learning spaces. Two factors drawn from the chart have significant implications for investments in physical and technological infrastructure:

1. Wireless everywhere—provides total campus coverage while supporting multiple protocols and devices (e.g., cell phones, laptops, PC's, etc.)

2. Multipurpose habitats—mixed-use and personalizable places rather than specialized locations like dedicated computer labs.

Further considerations expect that new buildings will be designed with open architecture so they can be adapted in the long term: interior walls may be movable/removable to meet changing learning needs; easy access to spaces for mechanical, electrical and yet-to-be-developed infrastructure will allow upgrading in the future. Formal learning spaces, such as classrooms and labs, will be designed and furnished so that they are agile—able to be adapted to a variety of learning needs and modalities within a very short time. Although there is a trend away from dedicated spaces, it is clear that there remains a need for certain specialized spaces such as campus computer resource centers, professional-technical class space (e.g., HVAC, Fire Science, etc.), and physical/applied science labs.

In an EDUCAUSE article, Long and Ehrmann aptly state; "A critical element in the design of new learning spaces is the need to design for change. Usage patterns measured over the years have demonstrated that students are not always using new facilities in the ways the faculty originally imagined." (p. 46). Spaces should continually adapt in order to best fit the curriculum as practiced by both students and faculty. Here we find another way that change serves as a driver and proof that flexibility and agility are success factors for the future. In addition, clearly, buildings may be designed to endure for a century or more, but college planners should expect to renovate the interior space at least every 25 years; spaces should be flexible enough to accommodate a variety of uses during this time span (George Copa, Ph.D., personal interview, May 12, 2006).

Adoption

Evidence collected in this study from both literature reviews and numerous interviews indicate that much of the current and near-future technology could be accommodated in present spaces with reasonable modifications. It is well to remember that students of all ages, with increasingly neo-millennial learning styles, will be drawn to colleges and community colleges that offer effective learning spaces and curricula, both physical and virtual. Harvard professor Chris Dede reminds educational planners that individuals of all ages share in a mixture of learning styles; be it neomillennial, millennial, or traditional (2005). From this, it can be surmised that the effective use of learning spaces, together with the implementation of

pedagogies and learning modalities—including 21st Century technologies—will provide an environment in which students can be successful.

Access

Students should have the freedom to identify and use the spaces that help them learn best. These spaces need to be available as much as possible. In the case of facilities at University of Washington, a number of learning spaces and services are available 24 hours a day. There are current examples of how students use these spaces for personal and collaborative learning. For example, technologies and space converge in a unique, student-centered initiative known as the University of Washington's Catalyst Web Initiative. This has resulted in award-winning, student sponsored and designed learning spaces which create opportunities for a number of self-directed and learner-centered activities. These spaces include TeamSpots (walk-up team collaboration spaces), a sound studio, and a unique digital presentation studio that allows students to practice oral reports, speeches, and dramatic readings (upon completion of the practice session, students can choose to have digital video files of the session emailed automatically to their accounts). These services and facilities are free and open to students to use in an assortment of production and practice capabilities. This provides a true collaborative computing workspace (Catalyst Web Site, 2006). In planning for future development, PCC should carefully consider the lessons learned at the University of Washington. It is conceivable that such a model could be adapted to fit the unique culture of PCC.

Conclusion

An important thread runs through this study: Teaching and learning of the future will be active and collaborative. Core curriculum is still the mainstay of all instruction and is designed around achieving the required course outcome guidelines. In addition, fundamental shifts in pedagogy and technology are helping students discover how to take initiative and use a number of new and alternative methods in achieving their learning goals.

Emerging best practices will be increasingly student-centered and responsive to students' needs and their changing expectations of flexibility and access. Using online quizzes and learning management systems, instructors will be able quickly identify what students already know or what they easily learned, and as a result, will be able to use face-to-face time in facilitating interesting, relevant, and interactive learning activities. Instructors will be able to quickly and easily develop ancillary materials and learning activities for students to access

outside of the classroom. The role of the educator will be a blend of instructor, facilitator, and collaborator.

The technology of the future will seamlessly support all types of learning activities. Wireless access and mobile devices (laptops, handheld's, iPods, cell phones) will allow almost any space to be or become a learning space. Anytime-anywhere communication and access to information will not replace good pedagogy or face-to-face learning activities; it will enrich them. The convergence of emerging pedagogy and emerging technology will create new synergies for learning. New paradigms of social interaction and collaboration will result in new contexts where learning can take place.

Emerging social and learning factors are driving this change of where learning occurs and how it is mediated. Technology is important, but secondary. Social factors of personal encounters, conversational negotiating of meaning, and new dynamic paradigms such as context are continually being created. In addition, because of a multitude of convergences, especially those between people, information and technology many new opportunities are emerging.

It is difficult to absolutely predict what the picture will look like in the future, but with certainty, we can expect that strategic investments in physical learning spaces, technical infrastructure, and professional development will keep the primary focus on PCC's core mission of teaching and learning.

Areas for Further Study

This study has explored much of the latest in research and practices of how the learning landscape is changing. There is always more to study, but we have identified the following areas that seem most promising and helpful in furthering PCC's attentive efforts in modernizing its educational mission and practices.

1. Student-centered culture – How can learning theory serve to help ground and support PCC's efforts in modernizing educational practices? How can student services be integrated to best serve the needs of students from entry point to exit? How can PCC stay informed of changing student needs? How can PCC assure student involvement in planning and decision-making processes?
2. Pedagogies - What pedagogical factors best serve both classroom-based and distance/distributed learning?
3. Learning models for Mobile Learning – How does mobile learning theory deliver practical content? What technical and pedagogical support is required?
4. Technology build-out - What is a technology build-out strategy and plan between now and 2020?
5. Faculty training and mentoring – How can we cultivate a culture that values awareness of, experimentation and pedagogy-driven adoption of emerging best practices? How can we facilitate for faculty the adoption of new practices and educational technologies?
6. Learning from other institutions - There are noteworthy programs in operation within easy driving distance of PCC from whom we can learn. An example is the Catalyst Project at the University of Washington and its mechanism for empowering a student-driven advisory council to decide how technology fee monies are used to further teaching and learning. (http://catalyst.washington.edu/)
7. Demographic trends – Social and economic shifts, student readiness, non-traditional students, ethnicity, high school students, etc.

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