The Virtual Computing Lab in K-12 Settings
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Background Issues
• Courses require expensive, school-owned software applications
• Students often forced to use labs—subject to crowding, restricted availability, and scheduling conflicts with classes.
• Software licensing and staff shortages limits flexibility in moving software between labs or school buildings
• OS and hardware limitations makes it difficult to maintain multiple high-end software apps on a computer at one time

VCL – Virtual Computer Lab
• Desktop as a Service (DaaS)
• Use remote desktop software to access servers running either Linux or Windows OS
• Leverage SOA tools and techniques to manage and provision remotely located blade servers
• Blades reimaged after each use
• Virtualization used to leverage CPU capacity
• SAN solutions to manage disk space

VCL History
• Begun as an university level solution for HPC and student computer lab management
• Offload high end apps from lab computers
• Individual student reservation or (later) block class reservation
• Expanded to a Community College pilot last year
• Expanded to a K-12 pilot this year

Pilot Study
Goals of the evaluation:
1. What logistics concerns presented challenges?
2. How robust and scalable is the VCL for community colleges and K-12 environments?
3. What are best practices for implementation?

Pilot Study
• Participants
  – Fall 08: 300 students in Introductory Computer Skills course, 35 in AutoCAD course
  – Spring 09: 15 Early College students in one school system added
• Data Collection
  – Student and instructor surveys, focus groups/ interviews, log data capture and analysis
Logistics

1. What kinds of problems did students have?
2. How were these problems resolved?
3. What was the impact on teachers and technical support staff?
4. What did usage patterns look like?

What Kinds of Problems Were Referred to the Help Desk?

- Low volume of help tickets
  - Problems copying to USB drives, accessing CD on image, some IE security issues
  - Problems typically resolved in one day
- Students reported very few problems to instructors
  - Occasional complaints about long waits for reservations or problems accessing the system

What Kinds of Problems Did Students Encounter?

<table>
<thead>
<tr>
<th>Reservation Wait Time (minutes)</th>
<th>Terminated Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 minutes</td>
<td>Normal 95%</td>
</tr>
<tr>
<td>1 minute</td>
<td>52%</td>
</tr>
<tr>
<td>2 to 5</td>
<td>42%</td>
</tr>
<tr>
<td>6 to 10</td>
<td>2%</td>
</tr>
<tr>
<td>&gt;10</td>
<td>3%</td>
</tr>
<tr>
<td>Cancelled</td>
<td>5%</td>
</tr>
<tr>
<td>Failed</td>
<td>3%</td>
</tr>
</tbody>
</table>

Reservations by Time of Semester

- Normal: 95%
- Cancelled: 5%
- Failed: 3%

Reservations by Time of Day

- 0 - 30 Min: 30%
- 30 Min - 1 Hour: 29%
- 1 Hour - 2 Hours: 13%
- 2 Hours - 4 Hours: 13%
- > 4 Hours: 5%

Length of Reservations
Important Factors

• Resources limited by peak demand
• Manage load over the course of a school day
  — Reservation scheduling during the day
  — Open use in the evening
• Tune reservation periods
  — Tight turn-around at end of periods with image preloading
  — Appropriate time-out periods and cancelation of block reservations

Scalability

1. Will students use the VCL?
2. What kinds of classes will benefit most?
3. How can instructors, IT staff, and administration prepare?

K-12 Interviews

• 6 high school students/one instructor.
• Students’ experience ranged from having no prior experience with the VCL to substantial experience with the VCL.

Student Feedback

• Most students thought the VCL was useful and would like to use it for other classes
  — One student did not see a need for the VCL because current resources were sufficient.
• The VCL allowed students access to software they could not otherwise use (most notably MS Office 2007).
• Although classes did not often require use of software unavailable on campus, students desired access to facilitate learning.

Feedback (2)

• The students reported that software runs on the VCL performed much better than on the local machines.
• Most students reported that they had encountered no problems with the VCL
  — One student did not initially understand the login process but had no trouble after some help was provided.

Teacher Feedback

• 20 min. training session was sufficient
  — No user error issues
  — One system outage noted at outset
• Regarding the VCL’s usefulness:
  “the VCL is a tool that can be used. If you know about it, then it will probably be useful to you because it has so many functions.”
Feedback (2)

• The VCL would be most useful in a computer-intensive class such as CS 110, which is an introduction to computers course.
• “Students in high school are very technology savvy. They are capable of acquiring nearly any software through piracy.”

Teacher User Requirements

• Unique, memorable (or no) logins
• Fast access
• No wait for reservations
• Little or no launch wait time
• File management that fits user model of local system
  – Doesn’t have to learn a new paradigm for file saving and management

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Teacher User Requirements (2)

• File management
  – Doesn’t have to learn a new paradigm for file saving and management
  – Can manage student files on network drive
  – Students and teachers can write to removable media

Teacher User Requirements

• Unique, memorable logins
• Reservation system that can coordinate with other teachers and schools
  – View of how many licenses are available on what days and times
  – Advance reservation months in advance
• Seamless linkage of teacher to student accounts
• Little or no wait time for app launch at beginning of class

VCL

• Easy install of apps
  – Remote install to server
  – No need to touch local machines
• License management
  – Limit number of simultaneous users
  – Specify teachers and schools
• Plays well with the network
  – Firewall
  – Bandwidth
• User interface is browser and OS neutral

Scalability

What kinds of classes will benefit most?

• Instructors report that any graphics design, pre-engineering, or programming classes will benefit
  – Software requiring dedicated graphics card calls is problematic
• High software costs increases payback of centralized management of licenses
• Guaranteed availability of software means increased use in class and for homework
• VCL also opens up the possibility of developing more hybrid and online courses

VCL

IT Mgr Requirements

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• License management
  – Limit number of simultaneous users
  – Specify teachers and schools
• Plays well with the network
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  – Bandwidth
• User interface is browser and OS neutral
### Scalability

#### IT Issues
- Need to test bandwidth
- CIPA issues – prevent traffic bottlenecks
- Staff required to create logins, build images, assist in troubleshooting
- Up front time commitment reaps long-term savings
- Implementation approach
  - Can contract through private companies
  - Set up individual school system solution
  - Set up regional or state-wide data centers

#### Lessons Learned
- Keep lines of communication open between IT, administration, and teachers
- Gain instructor buy-in
  - Few students will use VCL if teachers don’t encourage it
- Instructional support
  - Teacher professional development/VCL tutorials
  - Emphasis on encouraging teachers and students to use VCL
- Pilot with small set of able teachers and classes
  - Have a locally loaded solution on computer for back-up

#### Lessons (2)
- Establish and follow a timeline
  - Determine who will provide Tier 1 and Tier 2 support
- Create images and logins early
  - If VCL is not available on time, teachers and students will find other ways of accessing software
  - Frustration and impatience can occur as well if technical glitches are not ironed out early

#### Next Steps
- Simplify configuration for CIPA compliance
- Continue working towards 99.5% availability
- Refine block scheduling reservation interface
- Better training materials
- Simplify user file storage and management
- Mac OS support

### Questions?