How Vision, Collaboration, and Assessment Lead to a Successful Mobile Computing Program

Joni Spurlin, Kathy Mayberry, Charles Hunt & Dianne Raubenheimer
Vision, Collaboration, Assessment

- The Beginning .... Vision, Leadership, Collaboration

- Assessment ... shows success of the vision ...

- Leads to current activities, collaborations ...

- ... and to future vision
Leadership and Vision: The Beginning

Charles Hunt
and Kathy Mayberry
Fall 2000

- 90% incoming COE students bring computers
- Students wanted mobility
- Task Force – all departments represented
- Chairman of Task Force – Faculty member
- Must enhance student learning experience
- Funding through Compact Plan
- Search for Coordinator – Kathy Mayberry
Computer Ownership Among Incoming Freshmen
College of Engineering

- Percentage of students bringing computers
- Percentage of students bringing laptops

Year
- 1998
- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005

Percent
- 0
- 10
- 20
- 30
- 40
- 50
- 60
- 70
- 80
- 90
- 100

UNC TLT Conference March 2006
First Step

- Help students gain access to campus computing resources using their own computer.

- E115 Course—Introduction to Computing Environments; Empower students
  - Maintain their own computer
  - Effective use of their own computer to interface with campus computing infrastructure
Wireless arrives

- 802.11 a/b/g now makes mobile computing much more attractive
- More students bringing laptops
- Survey – Over 80% of the students felt that having a laptop enhanced their learning outside of class
Next Step – The Classroom

- Opportunities for active learning
- Laptops allow students to bring the “lab” to the “lecture”.
- Classroom evolution takes a while
  - Projects with small numbers of faculty
  - Faculty sharing with other faculty
Alleviating Concerns

1. Hardware
2. Software
3. Support for students
4. Students with high level of financial need
Alleviating Concerns

1. Hardware

- Do we need a computer requirement?
Computer Ownership Among Incoming Freshmen
College of Engineering

Percentage of students bringing computers
Percentage of students bringing laptops

Year
1998 1999 2000 2001 2002 2003 2004 2005

Percent
0 10 20 30 40 50 60 70 80 90 100

UNC TLT Conference March 2006
Timing of Laptop Purchase Among Incoming Freshmen

- June 2005 or later; 76%
- During Senior Year of HS; 12%
- During Junior Year of HS; 5%
- During Sophomore Year of HS; 1%
- Freshman Year of HS or Earlier; 1%
- Unspecified/Unsure; 5%
In the fall of 2006 the College of Engineering expects all incoming freshmen to bring a laptop or tablet.

We are striving to provide an environment that is supportive of student ownership.

Students who do not bring a laptop can “opt out” and will be scheduled for a lab section of the two introductory engineering courses (E101, E115).
Alleviating Concerns

2. Software

- Microsoft Office – Reduced price through the Select program for students ($60)
- Negotiating with vendors for software for students
- Some software can be loaded on student computer and monitored with a license server (Matlab, Solidworks)
- VCL – Virtual Computing Lab
3. Support

- Empower the student (E115)
- Peer groups helping each other
- Vendor support (Identify vendors who have a strong track of building quality laptops and providing excellent warranty support)
  - Warranty
  - Damage protection
- Engineering help desk
Alleviating Concerns

4. Students with high level of need

☑ Surveyed incoming students to determine which students are bringing a laptop
Method of Acquiring Computer

- Purchased with my own money; 28%
- Received brand new from parents; 47%
- Received via a grant or scholarship; 4%
- Received Used from family member or friend; 5%
- Received New from family member or friend; 5%
- Received a loan to purchase the computer; 3%
- Other; 7%
- Unspecified; 1%
Alleviating Concerns

4. Students with high level of financial need

- Providing laptops for a small number of high need students
How Do We Know If the Program Is Successful?

Joni Spurlin
Objectives

- To evaluate the impact of teaching with wireless laptops in a collaborative setting on student performance, specifically related to problem solving.

- To evaluate the impact of teaching with wireless laptops in a collaborative setting on faculty workload, pedagogy, and amount of material delivered.

- To identify the technical challenges using wireless technology in the classroom have for students, faculty, and technical staff.

- To measure satisfaction of students, faculty and technical staff with the use of this technology in academic settings.
Success Measured by:

- Influence on others
- Collaboration with others

Did we meet our objectives? The evaluation focused on 7 program objectives, including (a) the impact of teaching with wireless technology on student performance, and (b) the impact of teaching with wireless technology on faculty workload, pedagogy and amount of material delivered.

The detailed report can be found at ...

http://www.eos.ncsu.edu/soc/assessment/
Influence on Others and Collaboration with Others

- Engineering SOC collaboration with faculty in English, Mathematics, Graphics, Computer Science
- English Department – integrating the lab into the lecture by using their own labs and laptop carts
- Faculty used the laptop program to incorporate the lab section of the course into the lecture portion.
  - Computer Science
  - Mathematics
  - Chemical Engineering
- Influence on space design – wireless capabilities and new spaces
Selected Results

Selected results in four categories:

- Impact on student learning
- Student attitudes
- Faculty perceptions
- Infrastructure
Assessment Methods

- Direct Assessment:
  - Rubrics
  - Tests
  - Student course work

- Indirect Assessment:
  - Faculty surveys three times per semester
  - Student surveys end of semester
Student Learning: Enhanced Problem Solving

- Assessment results show that student had **significant gains** over non-laptop sections in regard to:
  - the **visualization** of the course content,
  - several dimensions of **problem solving**,
  - **graphics** and **computer-aided drawing**,
  - **programming** was improved in several sections.
Maple® Use in Calculus

Maple®, a modern engineering tool for visualizing concepts in calculus used to solve real world problems. In laptop sections students "Let Maple® do the sketching". As a result, they have the advantage of seeing the surfaces immediately in front of them as the instructor discusses the process.

<table>
<thead>
<tr>
<th>TEST Questions</th>
<th>Regular Section</th>
<th>Laptop Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two integrals - one used substitution and the other used integration by parts.</td>
<td>85%</td>
<td>87%</td>
</tr>
<tr>
<td>Convergence of a series</td>
<td>80%</td>
<td>76%</td>
</tr>
<tr>
<td>Students’ graphic understanding of the relationships among the integral, right sums and left sums for increasing functions</td>
<td>79%</td>
<td>94%</td>
</tr>
<tr>
<td>Graph the region between two curves and find the area between them. Then revolve this region about a line to produce a solid of revolution - find the volume of this solid.</td>
<td>69%</td>
<td>79%</td>
</tr>
</tbody>
</table>
Student Attitudes: Increased Student Engagement

- 73% ... laptops improved communication with classmates.
- 96% ... laptop gave them freedom to work any place, any time.
- 87% ... classes were positively affected by integrating laptops.
- 84% ... experience increased comfort in using their laptops.
- 85% ... laptops make learning more enjoyable.
- 84% ... in-class use of instructional technology stimulated learning.
- 99% ....prefer to use own computers than lab computers.
# Enhanced Learning: Students and Faculty Agree

<table>
<thead>
<tr>
<th></th>
<th>Laptop Students: % “Agree” Fall 2003</th>
<th>Laptop Students: % “Agree” Fall 2004</th>
<th>Faculty: % “Agree” Fall 2003</th>
<th>Faculty: % “Agree” Fall 2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laptops in class enhance learning</td>
<td>77%</td>
<td>77%</td>
<td>77%</td>
<td>79%</td>
</tr>
<tr>
<td>Laptops are a distraction</td>
<td>12%</td>
<td>19%</td>
<td>15%</td>
<td>21%</td>
</tr>
<tr>
<td>Laptops make learning more enjoyable</td>
<td>90%</td>
<td>86%</td>
<td>62%</td>
<td>79%</td>
</tr>
<tr>
<td>Use of instructional technology made learning more stimulating</td>
<td>84%</td>
<td>85%</td>
<td>69%</td>
<td>77%</td>
</tr>
<tr>
<td>Laptops improved communication with instructor</td>
<td>61%</td>
<td>54%</td>
<td>23%</td>
<td>36%</td>
</tr>
</tbody>
</table>
Students’ Opinions About Maple®

Regular Sections

- “Maple is a waste of my time.”
- “Made the material more confusing.”
- “It is horrible way to submit homework.”
- “It hurt my learning.”
- “I hate Maple! It is quite positively the absolute worst program on campus.”

Laptop Sections

- “At first, maple was aggravating. But after I learned how to use it, it helped my comprehension of the material.”
- “I really enjoyed having MAPLE on my computer. It made the class much easier not to have to head off to separate labs.”
- “It allowed us to work with more complex problems and find solutions faster.”
- “Maple is a pain to do, but I like the program.”
Faculty Attitudes: Increased Course Pace & Variety

- Increased Pace
- Greater Variety
- Increased Depth

- Fall 2003
- Spr 2004
- Fall 2004
Infrastructure: Decreased Technical Challenges

Faculty
- At the beginning of the semester, 60% spent time on technical issues.
- At the end of the semester,
  - 29% did not change plans due to technical difficulties
  - 32% changed plans once a month
  - 26% changed plans more than once a month
  - 72% said technical issues were solved in a timely manner

Empowered Students to solve own problems
- Developed E115 Course: students installed software and learned about technical issues.
- The number of logged help calls for the laptop program decreased by more than half after developed this course.
Decreased Technical Challenges

**Laptop Cart**
- Problem: Battery Life Dictated Scheduling Use
- Electricity: With 30 laptops/cart, used 30 amps
  - Needed dedicated circuit just for cart
- Carts were interim solution until students bring own

**Wireless Connectivity**
- ComTech added newer, faster standards:
  - Increased network speed, increased number that could be connected via wireless in a given area
  - Resulted in fewer problems due to better login management, an increase in the number of access points, and a diversified mix of wireless standards.
Current Activities and Future Directions?

Dianne Raubenheimer and Kathy Mayberry
Current Support Activities

- Faculty Support Program

- Involves
  - individual interviews and consulting sessions,
  - open meetings to share plans and discussions/materials on active learning and classroom management strategies,
  - follow up consultation meetings, classroom observations and feedback,
  - formal presentation of projects at a final meeting and faculty forums,
  - other professional development opportunities
Sample Projects

- Teaching Excel with Visual Basic stressing problem-solving algorithms
- Incorporating appropriate software into the classroom activities and developing software proficiency test
- Developing spreadsheet simulation of wastewater treatment plant
- Using short computer activities in nearly every class to reinforce lecture material
- Curriculum revision of E 115
- Including teamwork and cooperative learning using laptops, as part of their pedagogy
What We Are Learning

- Effective use of laptops or classroom computers takes time to learn
- Ongoing faculty support is vital for genuine course transformation (e.g. from experienced peers, pedagogical consultants, graduate students)
- There is renewed enthusiasm for teaching amongst most faculty, but even with support some faculty are not going to change
- Preparation time for the laptop section was increased because of modifications (stated by 62% of faculty involved)
What We Are Learning

- Faculty need help with classroom management strategies (particularly off-task behavior)
- In classes that are well managed, students rate their benefits at a higher level than in less well managed classes

Benefits Outweighed the Difficulties

<table>
<thead>
<tr>
<th>Percentage of students</th>
<th>Instructors</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>1</td>
</tr>
<tr>
<td>10%</td>
<td>2</td>
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<tr>
<td>20%</td>
<td>3</td>
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<tr>
<td>30%</td>
<td>4</td>
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<tr>
<td>40%</td>
<td>5</td>
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<tr>
<td>50%</td>
<td>6</td>
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<tr>
<td>60%</td>
<td>7</td>
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<tr>
<td>70%</td>
<td></td>
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<tr>
<td>80%</td>
<td></td>
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<tr>
<td>90%</td>
<td></td>
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<tr>
<td>100%</td>
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</table>
Spin-offs

- Faculty are increasing their use of laptops in subsequent courses
- Redesign of individual courses and sequences of courses is beginning
- Faculty are making presentations to peers and at conferences about their work
- Impacting laptop use in other colleges
- Cost-effectiveness of faculty development project
Assessing Student Learning

- Assessing the impact of technology on student learning needed to wait until faculty had developed courses and integrated technology.
- First needed to assist faculty with **HOW** to modify their pedagogy and use technology.
- Assessment of student learning was resumed Spring 2006.
- Assessment data is vital to provide evidence of how the use of technology can enhance student learning.
- This should include gathering **direct evidence** of student learning outcomes.
Spring 2006: Assessing Student Learning

- Developed assessment plans with faculty from the Spring 2005 laptop support program

- **Purpose** is to identify and assess specific student learning outcomes (SLOs) taught with the use of laptops

- Four courses being assessed
  - CSC 116 (6 sections) – assessing SLOs and attitudes in large sections with separate lab VS small sections with integrated labs
  - CE 325 – assessing student abilities to use SAP when students use laptops in class, versus when shown by the instructor
  - BAE 495 – assessing student learning outcomes using specific simulation activities
  - CHE 205 – assessing problem solving with and without excel

- **Mixed method research designs** being used
Where are we now?

Returning to the 2003 Goals

- Encourage students to purchase laptops - **Satisfactory Progress**
- Develop infrastructure to support technology in classrooms - **Satisfactory Progress**
- Provide faculty training in the use of technology and laptops - **Some Small Progress**
- Each department to identify courses in which to use laptops – **Little Progress**
Our Vision for the Future

- Students coming into engineering will bring laptops.
- Those who do not will ‘opt out’ of E101 and E115. It will not be compulsory.
- Power and wired access at each seat.
- Virtual Computing Lab (VCL)?
- Faculty using laptops in class for active learning.
- Faculty sharing approaches, successes and failures.
- Assessment data used for ongoing course improvement focusing on enhancing student learning outcomes.
- Assessment results used to advocate use of laptops/technology in class.
- Resources committed to support these activities.
Future Directions

- Continue working with faculty to provide **faculty development and support** through
  - consultants
  - faculty forums
  - departmental presentations
  - faculty development activities

- Continue working with individual faculty in **developing and implementing assessment plans** that focus on SLOs

- Use assessment data, esp. of faculty development and assessment of SLOs, to gain college wide support for the use of laptops, e.g. through CEC

- Work with departments within the college to identify particular courses in which to implement active learning with laptops
Some Questions for You to Consider

- How can faculty be motivated and systematically supported in using laptops and other forms of technology in class?
- How can effective pedagogical approaches and student learning results be most effectively disseminated to other faculty?
- How can assessment data be systematically gathered and used to support the vision?
- How can developments at the departmental level be initiated, supported and sustained?
- How can people and resources be mobilized to support these initiatives?
Discussion
Resources

- Resources on assessment of technology related to student learning: [http://www2.acs.ncsu.edu/UPA/assmt/litre/](http://www2.acs.ncsu.edu/UPA/assmt/litre/)
- LITRE Goals and Assessment Plan: [http://litre.ncsu.edu/dfiles/goals_short.html](http://litre.ncsu.edu/dfiles/goals_short.html)
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