

Using Palm Handheld Computers and the Internet To Increase Interactivity and Collaborative Learning in the Classroom

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Abstract: Palm handheld computers with wireless Internet access were used to promote active and collaborative learning in three biology courses. The effect of this technology on student learning was assessed using surveys, student journals, and scrutiny of student responses to exam questions. We conclude that students find collaboration and Internet access desirable for active learning activities and that their depth of understanding is enhanced by some of the exercises. However, technical malfunctions plus limitations of the Palm screen size and web browser lead us to recommend laptop computers, rather than handheld devices, for learning activities in the classroom.

Introduction

Like many educators, we have noted changes in students' aptitudes and attitudes in university classrooms over the years that make it increasingly difficult to retain their attention during lectures. This situation has prompted us to seek ways of adapting modern technology to enhance learning. We share a vision with a growing number of educators that true learning in the classroom occurs by doing, when faculty provide students with the opportunity to apply knowledge gained actively and collaboratively to problems in ways that complement individual leaning styles. Although technology has been viewed as a powerful enabling tool in this regard, its potential contributions to the learning environment have been limited by cost and by spiraling enrollments that lead to increased class size, especially in public institutions. In an attempt provide an economically feasible solution, we tested a model using relatively inexpensive, wirelessly networked, handheld devices to transform the traditional lecture-based classroom into an environment that promotes active and problem-based learning.

Use of Palms

Drs. Black, Niedzlek-Feaver, and Grubb utilized a classroom set of Wi-Fi enabled Palm PDAs in three classes: Evolution, Developmental Anatomy and Histology of the Vertebrates, and Principles of Embryonic Development. The Palms were Tungsten T5 models equipped with Wi-Fi cards (Figure 1). Separate Palm keyboards were used when writing was part of the classroom assignment. When not in use, the equipment was stored on a cart equipped with chargers for each Palm unit. Although the classrooms were Wi-Fi enabled, we had sporadic problems logging into Nomad and chose to use an Airport base station instead.



320 x 480 screen can be turned horizontally.

Rechargeable battery lasts several hours.

Bookmarks can be added to facilitate Internet access.

Figure 1. The Palm Tungsten T5 handheld device

The students worked in groups of 3-4 (Evolution) or in pairs (Developmental Anatomy), sharing one Palm within each group. Students in the Embryonic Development class worked independently, with each student using a Palm. The Palms were utilized to enhance classroom activities as follows:

1. Students constructed concept maps using Inspiration software and shared them with the class for discussion.
2. Students located articles or images via the Internet, took notes, and then posted their notes or subsequent essays on a shared class web site for use by other students.
3. Students answered quiz questions by accessing the WebAssign quiz site via the Internet, with student responses subsequently projected on the classroom screen for discussion.
4. Students read articles on a designated web site, chose a subject for a project based on what they read, and discussed their proposed projects in class.

Assessment

Students filled out questionnaires outside of class after each exercise, 5 in Evolution and 9 in Developmental Anatomy. Evolution students also kept a journal. During the class exercise utilizing concept maps, the Evolution class was held in a computer-equipped room. Students were divided into 3 groups that used paper, computers, and Palms, respectively, to complete the assignment. Student preference of tools for constructing and sharing the maps was subsequently assessed. On one day in Developmental anatomy, two graduate student assistants observed students during a class exercise and filled out forms using a detailed rubric to assess student engagement, collaboration and use of the Palms. In the Embryonic Development class, students filled out questionnaires after two class exercises.

Analysis of the questionnaires in Evolution (Table 1) revealed that a large majority of students believed that the class exercises enhanced their ability to communicate ideas, share content with other students, and understand concepts. Most students (83%) attributed their enhanced understanding of concepts to working with a partner rather than to working with the Palms (28%). Improvement of student comprehension was supported by Dr. Niedzlek-Feaver's finding that the students performed better

on exam essay questions related to concepts than in previous years when active learning was not utilized (data not shown). An interesting result on preference of tools (Figure 2) revealed that students preferred paper for constructing concept maps, but computers for documenting and sharing the maps. Use of Palms was rated below computers for all 3 activities, but higher than paper for documenting concept maps.

Table 1. Student assessment of Palm usage during 4 evolution classes

| Student Group | *This exercise enhanced my learning by: | | | *My understanding of concepts was enhanced by: | |
|-------------------|---|--------------------------|------------------------|--|-----------------------|
| | Communication of ideas | Ability to share content | Understanding concepts | Working with a partner | Working with the Palm |
| Exercise 2 | 11/13 yes | 9/13 yes | 12/13 yes | 10/13 yes | 4/13 yes |
| Exercise 3 | 8/13 yes | 9/13 yes | 8/13 yes | 10/13 yes | 2/13 yes |
| Exercise 4 | 15/17 yes | 13/17 yes | 15/17 yes | 15/17 yes | 4/17 yes |
| Exercise 5 | 14/15 yes | 13/15 yes | 14/15 yes | 13/15 yes | 6/15 yes |
| All | 83% yes | 76% yes | 84% yes | 83% yes | 28% yes |

* Students utilized the Internet to locate articles on specific topics or websites in which specific terms were used. This information formed the basis for subsequent class discussions.

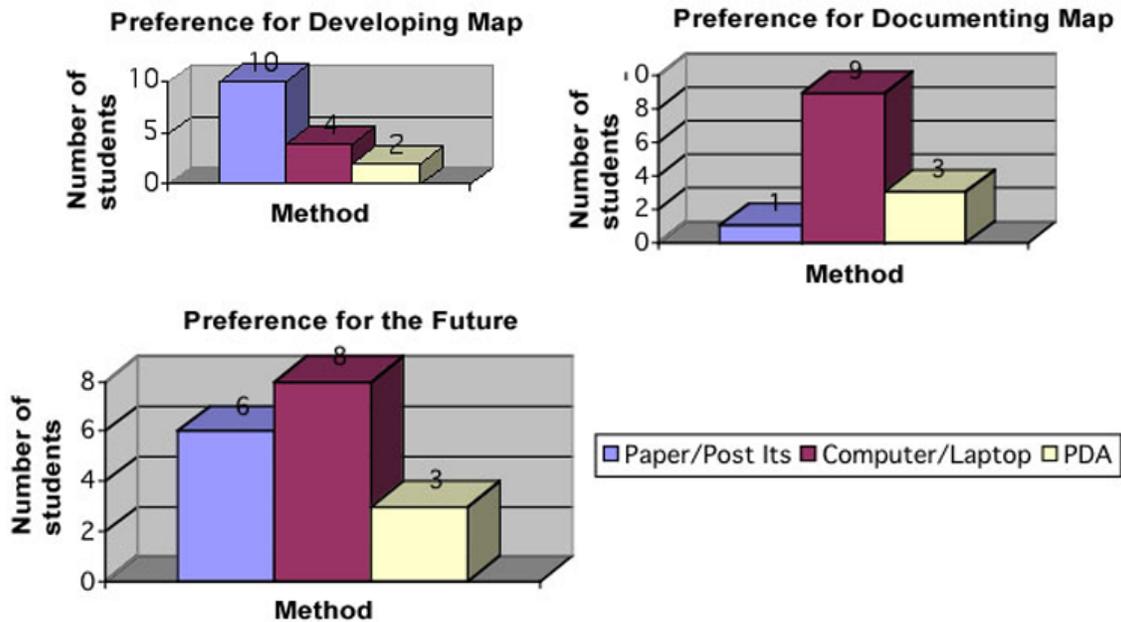


Figure 2. Student preference of tools for constructing concept maps in an evolution class

In Developmental Anatomy classes, questionnaires also revealed a student belief that the classroom exercises enhanced learning. The data from one typical questionnaire is shown in Table 2. Again, a majority of students thought that the exercise enhanced their understanding of concepts (71%) and working with a partner was judged more valuable than working with the Palms (86% vs. 71%). Analysis of student behavior during this exercise revealed that students spent most of their time using the Palm while working on the assignment. However, there was no correlation between student engagement, collaboration or time spent using the Palm with their subsequent grades on the essay written in class. This was due in part to differences in student efficiency. For example, student pair 3 worked hard, finished the assignment early, and spent the remainder of class discussing other topics. Hence, they received a low score on engagement, but the highest score on their essay. Data on class exercises in which on-line quizzes formed the basis of subsequent class discussion are shown in Table 3. Again, most students believed that the exercises enhanced understanding of concepts (70%) and that working with a partner was helpful (85%), but there was no difference in student scores on quizzes taken in class with a partner vs. outside of class working alone.

The Embryonic Development class used the Palms only twice. After the first class exercise with Palms, students rated the Palms as only slightly useful (a score of 2.5 for usefulness on a 1--5 scale). After the second class exercise, questionnaires revealed a student belief that the exercise enhanced their ability to communicate ideas (100%) and to share content (86%), but not necessarily their understanding of biological concepts (42%). This presumably reflects the fact that the exercise was designed to help students pick a project topic rather than to study new concepts during class. Only 29% of these students thought that the Palms positively impacted their work.

Table 2. Student assessment of Palm usage and instructor assessment of student performance in a Developmental Anatomy class in which students located images of skeletons on the Internet and wrote a short essay describing the bones

| Group | This exercise enhanced my learning by: | | | Understanding of concepts was enhanced by: | | *Rubric score for work on exercise (1 low--5 high) | | | Essay grade |
|---------------|--|--------------------------|--------------------------|--|--------------------------|--|---------------|-----------------------------|-------------|
| | Communication of ideas | Ability to share content | Understanding concepts | Working with a partner | Working with the Palm | Participation in the exercise | Collaboration | Time using Palm on exercise | % |
| Pair 1 | no no | yes no | no yes | yes yes | yes no | 4.66 | 4.66 | 4.50 | 80 |
| Pair 2 | no yes | yes yes | yes yes | yes yes | no yes | 4.50 | 4.66 | 4.50 | 70 |
| Pair 3 | yes yes | yes yes | yes yes | yes yes | yes yes | 3.66 | 4.66 | 5.00 | 100 |
| Pair 4 | yes yes | no no | no no | no yes | no yes | 4.33 | 3.50 | 4.00 | 80 |
| Pair 5 | yes no | yes no | yes yes | yes yes | yes yes | 4.00 | 4.50 | 5.00 | 70 |
| Pair 6 | no no | no yes | yes yes | yes no | yes yes | 4.00 | 4.66 | 5.00 | 60 |
| Pair 7 | no no | no yes | yes no | yes yes | no yes | 3.33 | 3.66 | 3.50 | 80 |
| All | 43% yes | 57% yes | 71% yes | 86% yes | 71% yes | 4.07 | 4.33 | 4.50 | 77 |

* Two graduate students utilized a rubric to assess student work during the assignment.

Table 3. Student assessment of quiz-based exercises and their quiz grades in a Developmental Anatomy class

| Group | This exercise enhanced my learning by: | | | My understanding of concepts was enhanced by: | | Average quiz scores (%) | |
|---------------|--|--------------------------|------------------------|---|-----------------------|--|---|
| | Communication of ideas | Ability to share content | Understanding concepts | Working with a partner | Working with the Palm | *Quizzes taken in pairs as class exercises (4) | *Quizzes taken alone outside of class (5) |
| Pair 1 | 2/8 yes | 3/8 yes | 4/8 yes | 7/8 yes | NA | 95 | 86 |
| Pair 2 | 4/8 yes | 4/8 yes | 8/8 yes | 6/8 yes | NA | 75 | 84 |
| Pair 3 | 8/8 yes | 7/8 yes | 8/8 yes | 8/8 yes | NA | 95 | 90 |
| Pair 4 | 3/8 yes | 3/8 yes | 3/8 yes | 6/8 yes | NA | 95 | 82 |
| Pair 5 | 4/7 yes | 5/7 yes | 4/7 yes | 5/7 yes | NA | 85 | 86 |
| Pair 6 | 1/6 yes | 4/6 yes | 5/6 yes | 4/6 yes | NA | 85 | 87 |
| Pair 7 | 3/8 yes | 3/8 yes | 3/8 yes | 8/8 yes | NA | 80 | 90 |
| Pair 8 | 4/7 yes | 5/7 yes | 7/7 yes | 7/7 yes | NA | 90 | 91 |
| All | 48% yes | 57% yes | 70% yes | 85% yes | **NA | 87.5% | 87.0% |

* Students worked in pairs to answer quiz questions during 4 in-class exercises. They also worked alone outside of class to complete 5 on-line quizzes during the semester. Student assessment of the value of these exercises summarizes responses of each student pair to the in-class exercises utilizing Palms.

** Most students felt that this question was irrelevant, since the Palms were used only to access the quiz site and submit quiz answers.

Student Comments

Most students valued the active-learning exercises and appreciated the ability to access the Internet during class. They especially liked the collaborative aspects; a frequent comment was “Two heads are better than one.” Students in Evolution had access to desktop computers as well as Palms for their classroom exercises during the semester, and generally were more critical of the Palms than students in Developmental Anatomy, who used only Palms. However, both groups of students noted that laptop computers would be preferable to Palms for most types of classroom exercises. Additionally, students and instructors in all three classes noted several negative aspects of Palm usage, related to technical problems:

1. Palm screens are too small to see details of images (especially regarding anatomy).
2. Palms do not always display web pages properly and cannot handle the simulations found on some web sites.
3. Palms close Internet connections after 10 min of non-use, causing students to lose work when writing essays on the WebAssign web site.
4. Palms sometimes disconnect from the Internet or “lock up” when students attempt to send work to a course locker.
5. Palms are sometimes tedious to use and can “lock up” (especially after logins), requiring the Palms to be restarted.

Summary

We found that active-learning exercises utilizing the Internet did stimulate critical thinking and interaction among students. The students, themselves, consistently rated “understanding of biological concepts” as the most valuable learning outcome of the exercises and indicated that working with a partner or group was highly useful in the learning process. The Palms were successfully utilized during class for making concept maps, locating articles and images on the Internet, writing essays, and taking on-line quizzes. Palms worked best (fewest technical problems) with the quiz-based exercises, and this format did stimulate subsequent class discussions. We conclude that access to the Internet is very useful for active and collaborative learning during class. However, Palm handheld computers are not adequate for many of these exercises. Furthermore a series of minor technical problems plus tediousness of use can discourage students and generate negative attitudes. We recommend that laptop computers be used for classroom exercises and hope to use inexpensive Apple ibooks in the future.

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About The Authors

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