



Tablet technology in first year calculus and linear algebra teaching

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Overview

- Handwriting in mathematics teaching
- How did I get involved in tablets?
- (Very) brief history
- Experiences
- Student perception
- Conclusions



Townsley (2002)

One reason we all use blackboards to write down mathematics is the symbols with which mathematics is communicated. Writing the symbols down gives the student a chance to read what has been spoken and thus access the content via several senses.



Loomes et al. (2002)

Students need to learn mathematical explanation



Handwriting in teaching mathematics

- Students part of development process, can contribute, comment, be shown alternate paths, spontaneously change
- More dynamic, flexible
- Can draw additional graphs, pose further problems
- Increases my motivation and engagement
- Passive lecture modes are tiring, tendency to cover material too fast
- Repeat lecture



Situation

- First year Calculus and Linear Algebra
- 320 students
- Three lectures each week, one tutorial, one prac class (Matlab)
- On campus students only



Lecture material

- Lecture material as workbook (PDF or for sale in print)
- Relevant material and blank boxes
- Fill in theorem, proof, part of proof, definition, graph, example during lecture



Lecture material (cont.)

- Intention:
 - Cover material quickly
 - Guide (new) lecturer, provide transparent curriculum, minimize preparation time, standardized way of presentation
 - More time to explain difficult concepts
 - More time to solve interesting examples in detail by writing out steps
- Instructor version: solutions typed



The lecture theatre

- Standard set up:

- Data projector and OHP until end of S1, 2004



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- S2, 2004:
 - Either data projector or OHP
 - OHP extremely bright
 - Lost eye contact with students
 - Headache/sore eyes
 - Tried for a couple of lectures
- Determined to use computer!
- Solution: write on computer!!!

(Very) brief history

- Tablet input device, Wacom (1988)
- Tablet PC (early 1990s)
- Windows XP Tablet Edition (2002)
 - Full version of Windows XP Professional
 - Additional features such as handwriting recognition, Journal software, Sticky Notes
- Used in manufacturing, graphics arts and design
- How about teaching undergraduate mathematics????



Graphics tablet

- Adobe Acrobat Standard

- Natural conversion from LaTeX to PDF
- Commenting function allows electronic ink
- Matlab graphs can be included
- Saved separate from document, can be edited
- “printed” to standard format PDF file to allow viewing with Acrobat Reader
- demonstration





Advantages

- Keep electronic record
- Refer back to previous slides
- Can save and post on website
- Can edit later, add notes, fix typos, tidy up
- Combination of prepared material and “live” working, interactive learning atmosphere, flexible
- Can cover material more quickly



Advantages (cont.)

- One medium only, no need to swap
- Easy to use
- Reply to student questions by image or PDF file (email or web forum)
- No need to type in LaTeX, saves time



Disadvantages

- Write blindly on tablet while looking at screen
- Hand-eye coordination required to go back to a particular location on screen
- Student attendance reduced if notes posted on web?

Tablet PC

- More expensive
- More versatile
- Easier to use
- No extra space needed for tablet





Student feedback

- Halfway through semester
- Answers: yes, no, don't care
- Space for comments
- 65 students participated



Student feedback (cont.)

- Writing in lectures helps my understanding
 - 89% YES
- I prefer if the lecturer writes on the computer
 - 80% YES
- I prefer if lectures are presented with an OHP
 - 85% NO
- I can read what the lecturer is writing
 - 79% YES, 9% DON'T CARE
- I think computer-generated lecture notes on the web site are great
 - 92% YES



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- The graphics pad is easier to see than the OHP
- Love the graphics pad! Very useful and modern, 1000x better than OHT



Conclusion

- Students acknowledge importance of hand writing in class
- Students like the graphics tablet
- Students prefer electronic ink to writing on OHPs
- Computer projection easier to see



Conclusion (cont.)

- Tablet is affordable and time-saving teaching tool
- Ease of use
- Lecturer can roam, when explaining concepts
- Notes can be made available on web
- Additional information can be posted
- Explored for on campus teaching – even more important for distance education!



Outlook

- Data for two more semesters
- Leads to conclusion that successful implementation correlates with
 - Lecturer's level of comfort with unknown technology
 - Technical difficulties encountered
 - Direct comparison with OHP use
 - Further use of the written material
- Other software? Better, cheaper?



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