Mobile devices in education

A report on five case studies involving the use of the Amazon Kindle ereader and the Apple iPad media tablet for educational use

Kosie Eloff, University of Pretoria
One organization with the aim of bringing books to schools in Africa

WORLDREADER
Worldreader and the Ghana Ministry of Education work together to select schools for the 400-student iRead pilot.

Books Open Brains

Books and the ideas in them engage minds and create opportunity, but only for the few. Families and schools in the developing world have access to vanishingly little written material. Worldreader aims to put a library of digital books in the hands of every family.

Making Headlines

The Wall Street Journal
Nonprofit Tries One-Kindle-Per-Child In Ghana

BBC
David Amanour covers the first days of the

Worldreader

• Digital books to all in developing world
• Identify schools, train teachers, work with communities, partner with publishers
• Companies (e.g. Random House, Amazon & government institutions e.g. USAID)
• Trial in Spain
• First project in Ghana
  – ~ 450 Kindles in schools
E/READER GUIDELINES

1. **POWER SWITCH ON**
   - Slide and release power switch to wake. Movement to your right.
   - Green light shows up to signify power on.

2. **POWER SWITCH OFF**
   - Slide and release power switch to sleep. Movement to your right.
   - Green light shows up to signify power off.

3. **WHEN POWER SWITCH ON TO TEXTBOOK**
   - Press Home button.
   - Search for textbooks on visuals.

4. **TO COURSE TEXTBOOK**
   - Use 5 ways controller to underline textbooks (by the cursor).

5. **TO SPECIFIC TEXTBOOK**
   - Enter by pressing 5 ways controller button in the centre.

6. **MOVE INTO TEXTBOOK**
   - Use 5 ways controller to underline the textbook (Mastering Social Studies for Junior High School: Bin Jusin and W).

7. **PRESS MENU BUTTON**
   - Enter by pressing centre of 5 ways controller.

8. **2ND STEP**
   - Use 5 ways controller to underline. Go to.....

9. **3RD STEP**
   - Enter by pressing center of 5 ways controller.

10. **4TH STEP**
    - Use cursor to locate table of contents, press center of 5 ways controller.

11. **CHAPTER/ TOPIC SELECTION**
    - Use cursor to select topic chapter.
    - Enter by pressing center of 5 ways controller.

12. **TOPIC SELECT TO READ**
    - The environment and environmental problems.

13. **READ FROM NEXT PAGE**
    - Press next page button from either side.

14. **READ FROM PREVIOUS PAGE**
    - Press previous page button from either side.

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MY E/READER

- Previous page button
- Next page button
- Power switch
- Charger hole

SO: ADEKU ADE, PRESBY JHS SOS MASTER
First 6 months of project

• Downloaded about 18000 free classics, newspaper samples, games
• Working way through ~ 35000 ebooks

✓ 50% more time reading (with ereaders)
✓ Test scores + 4.4% on average
✓ Reading comp. average + 13% (primary students)
✓ Language fluency and dictation improvement
First 6 months of project

<table>
<thead>
<tr>
<th>TOP 5 DOWNLOADS</th>
<th>Books</th>
<th>Magazines</th>
<th>Games</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><em>The Holy Bible</em></td>
<td><em>Winding Road Weekly</em></td>
<td><em>Every Word</em></td>
</tr>
<tr>
<td>2</td>
<td><em>Beauty and the Beast</em></td>
<td><em>International Herald Tribune</em></td>
<td><em>Shuffled Row</em></td>
</tr>
<tr>
<td>3</td>
<td><em>Cinderella</em></td>
<td><em>The New York Times</em></td>
<td><em>Minesweeper</em></td>
</tr>
<tr>
<td>4</td>
<td><em>I Love You This Much: A Song of God’s Love</em></td>
<td><em>The New Yorker</em></td>
<td><em>Number Slide</em></td>
</tr>
<tr>
<td>5</td>
<td><em>The Jungle Book</em></td>
<td><em>Newsweek</em></td>
<td><em>Dots and Boxes</em></td>
</tr>
</tbody>
</table>
E-ink based ereaders for educational purposes

CASE STUDIES
Kindle DX study

- Princeton University
- Case Western Reserve University
- Reed College
- Arizona State University
- Pace University
- Darden School of Business, Virginia University
- University of Washington
Kindle (left) vs. Kindle DX (right)
Kindle DX latest generation ($380)
1. Reduce printing & photocopying (3 courses)
2. Using tech. in the classroom equals (or betters) typical classroom experience?
3. Explore strengths & weaknesses of current e-reader technology
   (suggestions for future devices)
Three courses (3 faculty, and 51 students)

Goal of printing less in the pilot courses
  - Participants printed just over ½ amount of sheets than control groups

Classroom experience somewhat worsened
  - Study & reference habits challenged by device limitations
Princeton University

• Pay more attention to
  – Annotation tools
  – Pagination
  – Content organization
  – More natural paper-like experience

• Most pleased with Kindle reading experiences
  ✗ Writing tools fell short of expectations
Princeton University

- 94% said they used less paper

<table>
<thead>
<tr>
<th>Course</th>
<th>Average paper use, Kindle owner</th>
<th>Average paper use, control group</th>
<th>Relative difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>WWS555a</td>
<td>962</td>
<td>1826</td>
<td>53%</td>
</tr>
<tr>
<td>WWS325</td>
<td>762</td>
<td>1373*</td>
<td>55%</td>
</tr>
<tr>
<td>WWS5xx with 24% enrollment of pilot participants</td>
<td>570</td>
<td>1508</td>
<td>38%**</td>
</tr>
</tbody>
</table>

*extrapolated from Fall '08 usage of 1144 sheets per person, with 20% per annum increase

** Kindle users in this class were well below the mean of their pilot peer group in WWS555a, apparently because they used the Kindle in two classes instead of one. There is little else to account for the difference.
Favourite features (Kindle)

- Battery life
- Wireless connection
- Portability
- All course reading on one device
- Ability to search for content
- Legibility of the screen
- Can be read in full sunlight
Areas of improvement (Kindle)

• Ability to highlight and annotate PDF files
• Improving the annotation tools
• Providing a folder structure
• **Improving the highlighting function**
• Improving the navigation within and between Kindle documents
Superb annotation tools critical for success

When told that additional features would impact battery life, most students prefer to stick with grayscale & e-paper, except:
  – Highlighting
  – Addition of touch screen, stylus would be better
Kobo Touch, revealed May 2011
Nook Touch, revealed May 2011
Reed College

• ~40 students in 3 courses  (upper division)
• Kindle DX to read texts and other materials
  (Also considered iRex iLiad, the Interead COOL-ER, the ECTACO jetBook, the Barnes & Noble nook, and several Sony Readers)

Goals

• Assess e-book technology for curricular use
• Identify impacts of technology on teaching & learning
• Identify features whose modification (or addition) would improve usability for curricular purposes
Potential long-term benefits:
1. immediate, searchable access to materials
2. reduction in total cost of course materials
3. reduction in use of paper
4. opportunities to share electronic comments
5. integration of e-book technology with other curricular tools (e.g. Moodle, Reed's open source learning management system)
Reed College

• **English 301:** Junior Seminar in English
  – Irony, Allegory, Epic, Novel

• **French 451:** Special Topics in French Literature
  – *The History of Truth and Authenticity from Montaigne to Sartre*

• **Political Science 422:** Nuclear Politics
  – *The origins and effects of the spread of nuclear weapons*
Reed College

Participation and Benefits

• Entirely voluntary, paper versions available
• Participants receive Kindle DX
• Participants provide required feedback
• Allowed to keep Kindle DX at conclusion
Reed College - Benefits

1. **Legibility** (e-ink vs. LCD)
2. **Form factor** (comfort, workspace use)
3. **Battery life**
4. **Durability**
5. **Paper savings** (very promising)
6. **Distribution** (especially wireless)
7. **Single-function benefit** (specifically in class)
Legibility

• Eink, light contrast between text and less sharp than paper, read for many hours without visual fatigue
• Some expressed preference for the Kindle display
• Few felt (laptop) LCD displays as comfortable for reading text
Form factor

- Size, weight, general configuration
- Hold comfortably for many hours of reading
- Carry easily in backpacks
- Use in class without cluttering workspaces
- Smaller eReaders maybe be better for travelling but preferred the larger screen for academic use
Battery life

• Praise for "long distance" battery life
• Wireless feature turned off week or more without recharge
Durability

• Initial concern about fragility of eReader (padded Kindle cover)
• Turned out to be quite durable, even with cover removed.
Paper savings

• Expected to cut down dramatically on printing, which proved to be the case
  – E.g. one course ~ 70 articles

• Most reported that able to read articles in PDF format on the Kindle well enough

• Many view this as most promising aspect of electronic materials
Over-the-air distribution

• Number of students indicated they purchased items (or acquired free texts) online for pleasure reading or other personal uses
• Delighted to be able to download a text in a minute or less
• Ease of browsing books in the store
• Wide selection of titles
• Lack of cell charges
• Speed of downloading texts from any location
• **Platforms that required a computer connection for text downloading seemed cumbersome by contrast**
Single-function benefit

• Discussion about long-term viability of single function devices (i.e. reading text).
• Faculty noted use of Kindle DX in class didn't lead to distractions are typical of laptop use.
• Functional limitations proved to be beneficial for class discussion dynamics.
Reed College - Challenges

- Materials availability
- PDF formatting
- PDF distribution
- Images and colour
- File system
- Page refresh and skimming
- Referring to texts in class
- Highlighting and annotation
- Content comprehension
- Cost considerations
Materials availability

• Not all readings could be obtained by Amazon
  – E.g. French literature course instructor had to provide most material (primarily public-domain etexts)
  – No integrated, searchable French-English dictionary would be available in addition to New Oxford American Dictionary
Materials availability

• Books available for other two courses, but not pref. edition.

• Students expected to read many journal articles (normally online through library’s e-journal subscriptions)

• Limited capabilities of Kindle web browser (needed to convert articles)
PDF formatting

• Can read PDFs but lose annotation, highlighting, text-resizing, text-to-speech, etc.
• Conversion required time, esp. for older articles
• Special care for footnotes, two-column page layouts, charts, and tables
• Conversion took at least an hour, often more
PDF distribution

• Amazon not involved in processing of assigned articles
• Faculty hesitant to store copies of articles on Amazon's servers (even temporarily, due to concerns about Fair Use)
• Uploaded to appropriate course areas in LMS
• Hence, PDF distribution cumbersome
Images and colour

• Relatively low screen resolution and greyscale display
  – Readings for study did not rely heavily on images or colour
File system

• “Home page" listed materials linear fashion.
  – Can be sorted alphabetically by author or title, or chronologically by the date last opened

• No organizing materials in conventional folder hierarchy.
Page refresh and skimming

• No problem if search were easier & faster

• “Flipping through the pages” important
Referring to texts in class

• Courses centred around careful reading and discussion of assigned texts
• Expected to support their claims with specific textual evidence
• Use location numbers (font size & word density can be changed)
• Location numbers tied to specific points in texts (but difficult to reach with interface)
time and money.

CHASUBLE. Am I to understand then that there are to be no christenings at all this afternoon?

JACK. I don't think that, as things are now, it would be of much practical value to either of us, Dr. C. I have a number of important duties to perform from morning till night, and I have postponed the writing of my concluding speech for the week. Therefore, it is essential that I get back to the church and get things ready. Is this to be allowed?
Referring to multiple texts

• One text at a time

• Hard to navigate smoothly between multiple texts (e.g. class use)

• Use of location numbers complicates citation

• Many gave up using Kindle in class
Highlighting and annotation

- Five-way controller
- Notes only at bottom of screen
- Highlighting less problematic, but still suffered (controller)
- Kindle **iPhone** uses similar structure, but **touch navigation**
- Same tasks in iPhone / Kindle (which took twice as long)

“*Technology will need to match flexibility and ease of jotting notes on paper, flipping from page to page, and spreading multiple texts across a desk*”
“Like I told you...” Collin pulled into the slow-moving vehicle lane to allow a short string of cars to pass him. “We’re in northern Oregon now. We’ll be heading into the Cascade Mountains in a few minutes. I just hope we can make it over without too much trouble. Ol’ Queenie almost bought the farm going over the Rockies.”
Content comprehension

- Faculty member felt comprehension suffered
- Difficulty with highlighting and taking notes leads to passive reading
- Evidence in assignments & class discussion
- Faculty & students agreed:
  - issue is critical to academic use of eReaders
  - easily addressed by technology for quick and easy text highlighting and annotation, etc.
Cost Considerations

• At time of price of Kindle DX - $489.
• Others varied from $199 to $859
• Price needs to drop dramatically (< $100)

• Many would spend much more for multi-function
  – If it eliminated the need to own a laptop
  – If as comfortable as eReader for long reading
Reed College

• Students & faculty unanimous in reporting that Kindle DX (currently) was unable to meet their academic needs
• Many felt that once technical and other issues have been addressed, eReaders will play a significant, possibly a transformative, role in higher education
• Broadly: how students did academic reading (those who incorporated e-reader into routines and those who did not)

• 39 1st-year graduate students in CS & Engineering, 7 women and 32 men, from 21 to 53 years old.

• 7 months into study, less than 40% of students were regularly doing academic reading on Kindle
  – Reasons included lack of support for taking notes and difficulty in looking up references
University of Washington

• **Professor Charlotte Lee** from UW's Department of Human Centered Design & Engineering

• Continued to interview students over nine-month period

• Reading habits, with or without the e-reader?
1. Most reading in fixed locations
   - 47% at home, 25% at school, 17% on bus, 11% coffee shop or office

2. Kindle more likely to replace paper-based reading than computer-based reading
3. Continued to use the device
   – some read near computer to look up references
   – others, sheet of paper into the case for notes
4. With paper
   – ¾ marked up texts as they read
   – highlighting key passages, underlining, drawing pictures, notes in margins, etc.
University of Washington

5. Difficulty of switching between reading techniques, e.g. skimming illustrations or references before reading text

6. Cognitive mapping disrupted (physical cues to help retain and recall information)
University of Washington

**Professor Charlotte Lee:**

• Software will help address some issues over time
• Niche software for styles specific to certain disciplines?
• PCs, laptops, tablet, paper, will play role in academic reading
• eReaders will also find their place
• May be similar to today’s music industry
• E-readers not where they need to be
• Improvement “sooner than we think.”
CASE STUDIES

LCD-based media tablets for educational purposes
Pepperdine University

• Three-term study to assess iPad potential in education

1. Exploratory research to inform research design (fall 2010 & spring 2011)

2. Assess potential to enhance student learning outcomes (fall 2011)

• Compares technology use & engagement for students:
  – One section is loaned iPads
  – Other section uses various computing devices
  – Undergraduate and graduate courses
Pepperdine University

Data Collection

• Pre-term technology use survey
• Classroom observations
  – The use of the iPad/laptop/mobile devices by students
  – The structure of class time and teaching style
  – Students’ activities during class
  – Group learning activities, etc.
• Focus groups with students.
• Post-term technology use survey
• Post-term interviews with participating faculty
• Collection of grades
Fall 2010

Calculus I
1. GraphCalc HD
2. Underscore Notify
3. Numbers
4. DropBox
5. Groupboard

Law School Course
1. Penultimate
2. Keynote
3. Quickoffice Connect
4. I-annotate PDF

Spring 2011

Calculus 1
1. GraphCalc HD (Cost: $1.99)
2. Underscore Notify (Cost $1.99)
3. Numbers (Cost: $9.99)
4. DropBox (FREE)
5. Groupboard (FREE)

Nutrition
1. Wellness Dice
2. iAmino
3. Protein Rich foods
4. Nutrient Facts
5. My Nutrients
6. FoodTracker Pro
7. Calorie Tracker
8. Metabolic Syndrome
9. EatRight Daily Food Log

Religion
1. Bible Reader for Bible Studies by Olive Tree
2. NRSV Bible Reader
3. Pocket Dictionary Biblical Studies
4. Carta Compact Atlas HD, Bible Maps

Business
1. Keynote
2. Pages
3. Numbers
4. Hotel Tycoon
5. iAnnotate PDF
6. Study.Net
7. DropBox
Part 1: Get to Know Keynote

Explore the toolbar.

Presentations
Create new presentations and find the ones you’ve worked on before. Your progress is saved automatically as you work.

Undo
Anything you do can be undone with just one tap. Touch and hold to redo.

Toolbar buttons
- Info: Change object or text properties.
- Insert: Add a photo, table, chart, or shape.
- Animation: Animate slides.
- Tools: Search, check spelling, and more.
- Play: Play your presentation.

Remote Settings
Enable Remotes: ON

Darrell’s iPhone
Linked remotes can control Keynote when a presentation is playing.
<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
<th>SUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/1/2010</td>
<td>12 Post Office</td>
<td>2</td>
</tr>
<tr>
<td>Apr 2, 2010</td>
<td>iCafe</td>
<td>0</td>
</tr>
</tbody>
</table>

The calculator is open with the following numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, and the following functions: addition (+), subtraction (-), multiplication (×), division (÷), percentage (%), and square root (√). The calculator also has a 'functions' button and a 'true/false' button.
BENZENE

- AROMATIC HYDROCARBON
- CONJUGATED DOUBLE BONDS
- Kekulé Proposed, 1865

represented as:

[Chemical structure drawings]
Last healthy day: 11/19/2009
New day starts at: 9:11 AM
Meal plan profile: Custom plan
Icon theme: Default

Average female
Average male
Custom profile

Grains
Vegetables
Fruits
Milk and Dairy
Meat and Protein
Water

Milk and Dairy:
- 1 cup = 1 serving
- 1 yogurt
- 1 slice of cheese
- 1 cup of skim milk
- 1/2 cup cottage cheese
- 1/2 cup pudding
- 1/2 cup ice cream

+ Protein
Pepperdine University

How helpful was iPad for sharing information in class?

• ~75% of students: very helpful or slightly helpful
• “We’ll try to help each other to make sure we’re all at the same page”
• “You’re more likely to help each other when it’s portable and you can see what each other is doing.”
• Saw sharing of images, reference content (from apps and the Internet), and in-class notes
Pepperdine University

What is the value of the iPad?

• “The iPad can do everything”
• “Not just a clicker or an e-reader”
• Capacity to be a communication, productivity, and gaming device
What is the iPad's purpose?

• No specific purpose until given purpose
• [Tablets] no reputation as productivity tools
• Productivity apps not helpful until encouragement / guidance
• Gaming apps can be learning tools
<table>
<thead>
<tr>
<th>What works?</th>
<th>What doesn't?</th>
<th>Why</th>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Student peer pressure or Faculty require use apps</td>
<td>Faculty encourage use or Apps used for homework</td>
<td>Most students will not take time to learn something new unless they have to</td>
<td>- Group work</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Assignment to learn to use app</td>
<td>- App required for test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Quotes</td>
<td></td>
</tr>
<tr>
<td>Faculty member knows app well, encourages students to teach each other with class activities</td>
<td>Faculty member does not know how to use the apps required for their course</td>
<td>If faculty member is frustrated with app, most students won’t even bother</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Usage notes</td>
<td></td>
</tr>
<tr>
<td>Encourage use of iPad with everyday useful apps for note taking, email, PDF, eReaders, etc.</td>
<td>Jumping right into complex app use or assignments when students are not comfortable with the iPad</td>
<td>There is a learning curve to using the iPad</td>
<td>- Quotes</td>
</tr>
</tbody>
</table>
Oklahoma State University

- Fall 2010, five sections of two courses across two colleges and two campuses
- School of Media and Strategic Communications, School of Business
Oklahoma State University

Did the iPad increase or decrease expenses? ✓

• Evidence suggests decrease in student expenses
  (with maximum integration)
• eBooks less expensive than traditional textbooks
• Saving could cover hardware costs in 2 semesters
• Possible decreased paper and printing costs
• Cloud computing could reduce future network storage needs
How was iPad used (students and faculty)?

- Professional & personal benefits
- Students used iPad in ways outflanking PC
- Substitute for paper and pen
- Faculty can explore & recommend apps
- Built-in browser – web more readily available
Integration of eReader enhancement or detraction?

• Mixed responses
• Students liked using iPad to **house their textbooks**
• Students suggested it promoted more reading
• However, e-book reading decreased
• Students thought would use iPad as e-reader, but didn’t do as much as planned
Integration of iPad an enhancement to the academic experience?

• 75% agreed or strongly agree with: “I think the iPad enhanced the learning experience of this course”
  – 92.8 % among students who owned a Mac
  – 70.4 % among students who owned a PC

• ~3% (in one course): opt out of iPad course for identical course without iPad
Integration of iPad an enhancement to the academic experience?

• Faculty perspective:
  – uniform hardware and software available
  – knew students had access to same learning tools
  – above critical when planning assignments, activities
“Because of the overall improvements to the academic experience of both faculty and students it is our recommendation the University should consider the full deployment of iPads for all students”
The urgent need for books in African schools

TEXTBOOKS
Need for books in African schools

- Textbooks 2nd most important factor in a good education in Africa
  - ahead of teacher training and the number of pupils in a class.
  - only “home background” of pupils proved to be more important.
Books Change Lives

We believe that books change lives. View one of our short films below to find out how.

You can make a donation to our Books Change Lives campaign by clicking here. For every £6, we will be able to send 3 more books to libraries like those featuring in the films below. If you’d like to order these films on DVD for an event e-mail us or call 0207 7333577.

Books have changed the lives of all the people below - click on a photograph to find out more!
Book Aid International

• Increases access to books
• Literacy, education & development in sub-Saharan Africa
• 507,787 new books to over 2,000 libraries in 2010
• More than 30 mil. books to partner libraries since 1954
LIBRARY HOURS

WEDNESDAYS 3.00 – 4.00pm

SATURDAYS 9.30 – 10.30am

Hogsback, Eastern Cape
Ebooks as textbooks - challenges

• Electricity
  – Africa - 4% of world’s electricity
  – 16,000 schools in content without electricity

• Equipment capability (e.g. smartphone %)

• Government fiscal policies

• Security (copyright and piracy concerns)
Thank you! Comments or questions?

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