A Perfect Storm: Preparing for a new era in K12 education  
(April 2013)

This paper is background for a discussion between OneNote and the tech-savvy educators behind very advanced deployments built on OneNote, to identify simple tools that could make the powerful platforms they have built easy for all schools to deploy.

Based on discussions with Cal Armstrong of Appleby, Rob Baker & Jeff Spain of Cincinnati Country Day, Michael Vasey of DyKnow, Kimberly Mecham of St. Thomas, John Christy & Joe Tront of Virginia Tech, and Andrew Asikainen & Mark Payton of Whitfield. Contact: Jonathan Grudin, Microsoft Research.

“OneNote is the holy grail of education, a game-changer.”
“OneNote is a product that—Microsoft doesn’t realize what it has on its hands.”
“With the Tablet PC, Microsoft has created the most powerful, if unsung, platform for the support of education that exists today.”

Key messages
1. **1:1 will rise dramatically over 1-5 years** with new online-only assessment requirements in the U.S.
2. The stylus is heavily used by 1:1 students and teachers and may be required for 2017 assessments.
3. OneNote is a powerful tool in K12 education when used across classes in 1:1 tablet deployments.

Key points easily overlooked
1. **Not many professions routinely use a stylus or pen to create final product. K12 education is one of them.**
2. **2013 really is different, because demand will push tablet prices down dramatically within a year or two.**

Key opportunities
1. Support the tricky beginning-of-term school-wide 1:1 OneNote deployment that effective use requires.
2. Market the advantages of OneNote and stylus in education more effectively with help from schools.

Setting the scene
On March 28, 2013, bids were due on contracts to provide 630,000 stylus-enabled devices over 18 months to the Los Angeles Unified School District. Schools across the United States are rushing to adopt the Common Core standards in mathematics and language arts that 45 states agreed to. Annual student assessments will be online-only in 2014-2015 and could require stylus use by 2017. Cycling kids through computer labs for online assessment in the testing window won’t be practical in large schools, and students will fare better in online testing with more online experience, hence the shift to 1:1, where each student has a personal portable device used in classes in school and at home, on field trips, and so forth. Rapidly expanding demand through contracts such as LAUSD’s will accelerate the decline in tablet PC prices.

The shift to Common Core pedagogy, which emphasizes “21st century” skills such as critical thinking, communication, collaboration, personalized and project-based learning, adds to the existing challenges faced by teachers and students. Technology can simplify and amplify pedagogy. For example, in a “station rotation” model, one-third of a class might work on exercises on a bank of computers with adaptive software that matches problems to a student’s performance, one-third on collaborative efforts overseen by a teaching aide, while one-third get a lecture or individual attention from the teacher; then they rotate. Another approach is the “flipped classroom”: Prior to class students watch a video lecture (from Khan Academy, VideoNerd, Discovery Learning, etc.). Class time is spent solving problems and interacting. This blends the massive open online course (MOOC) university concept with traditional face-to-face education.

These approaches are not mutually exclusive. Together with the coming wave of 1:1 device deployments and Common Core, education will unquestionably be transformed. Low-end devices such as Kindles or iPads are used primarily for content consumption. This can eliminate the need to carry books. But schools
have demonstrated that when every student and teacher carries a networked tablet with a physical keyboard and active digitizing styluses, the capability for addressing 21st century challenges explodes.

Schools have been among the most paper-based of environments. Students carry large notebooks with sections for each class. Homework and quizzes are collected, marked, returned—a major time sink. The rising use and creation of audio and video content does not mesh with physical notebooks. The central point of this whitepaper is that when properly configured in a 1:1 tablet deployment, Microsoft OneNote has proven to be extraordinarily well-suited for classroom use in the 21st century. It wasn’t designed with this use in mind, but schools with thoughtful deployments describe it as “the holy grail of education.”

1:1 deployments have been few, but we have learned from the pioneers who succeeded. This document identifies such lessons—teachers and students have identified a breathtaking range of activities and efficiencies when they use networked devices equipped with a stylus and OneNote, which is free for education with Office 365. Not every teacher will embrace technology, but the benefits increase as more do—students get more experience, teachers share techniques, and everyone finds and invents new uses.

A 1:1 school OneNote deployment

*Humanities teacher Martin’s class G Notebook.*

Martin selects student Gentile’s Notebook…

... then the “Religion” Section tab…

... and finally her “Class Notes” Page.

This is the Humanities G course OneNote notebook of Martin, a (real) teacher in a school with a 1:1 tablet deployment. Links to student notebooks for that class are on the left (Babb, Blackburn, etc.). He has selected Gentile’s (pronounced “Jen-tilly,”) so her seven Sections appear at the top. For example, ONE MIN WRITE has class writing exercises. Martin selected the Religion section, which contains four Pages (documents) listed on the right. He selected “Class Notes.” The other pages are study guides and a digitized book chapter that she pasted in. Her OneNote pages are repositories for handwritten and typed input, PDF and word documents, slides, spreadsheets, images, and links to audio, video, and web sites.
A school-wide deployment requires OneNote Notebook construction on a scale rarely if ever seen elsewhere. Consider a high school with 1200 students, each taking 7 classes, and 100 teachers, each teaching five. On the first day of the term, to give each student one Notebook per class, 8400 must be created! Each teacher has one per class, 500 more, with one entry per enrolled student linked to the student’s notebook, 8400 entries. Teachers can access their students’ Notebooks; student access is restricted. Each student Notebook has multiple sections. Some teachers ask for standard sections (e.g., Class Notes, Homework, Quiz-Test). In the first week or so, tens of thousands of sections are created, each to accumulate multiple pages of content. When a student shifts classes, the system must be adjusted.

Schools have relied on physical student notebooks, teacher grade books, assignments that are distributed, and homework exercises that are completed, turned in, marked, and returned. Technology can help manage this and expand to include media beyond paper. Most students in U.S. grades 6-12 carry heavy textbooks and one or more physical notebooks with tabs for 5-7 courses. A tablet can hold the textbooks and replace the physical notebooks. Reading textbooks digitally is convenient but not revolutionary. Education is transformed, however, when every student and teacher accesses a device at school and home that also allows the production, sharing, and viewing of written notes, typed text, audio, and video; provides access to the expanding wealth of free and low-cost educational tools and content on the Web; and supports communication and collaboration, facilitating creativity and project-based education.

In the example, Martin can mark on Gentile’s Class Notes and she has immediate access to the feedback. He can then click on the next student and continue through the class. Without exchanging paper, teachers can mark, grade, and review individual assignments or quizzes, or entire notebooks.

Given the efficiencies for students and teachers, why isn’t this better known? Device-per-student deployments are still rare—we are on the leading edge of a rapidly-approaching wave. Some existing 1:1 deployments are of devices that are primarily useful for content consumption. The most successful deployments we have seen utilize not only OneNote and a physical keyboard but also a stylus with an active digitizer, which is far more useful than low-resolution capacitive touch devices such as the iPad. Another issue is the setup effort required to create the notebook structure. A school must take this on at the beginning of a term rather than leave it to teachers and students to implement.

Experience shows that benefits increase substantially as more classes use these tools. Students become more adept, versatile and creative with them. Teachers share techniques. A stylus becomes a powerful device, well worth the bother of keeping track of it. It is easy to underestimate the value of a stylus because in most disciplines, handwriting or sketching may be used early in a work process but is not part of the final product. In a few fields it is—education is one of them.

**Challenges**

OneNote does not support the massive, time-pressured, school-wide setup and student-class assignment maintenance. Nesting student Notebooks so that they appear as Section Groups in teacher Notebooks is unsupported and leads to tricky, error-prone assignment of access permissions, described below. Each version of OneNote has forced changes in this process for schools that have undertaken it by brute force, Powershell scripting, or Sharepoint procedures. As a result, in most 1:1 schools only a few teachers adopt OneNote and in a less effective way. Without a critical mass of use, the benefits for everyone are limited.

Other desirable features are managed by only some of the power-user schools. For example, a teacher might want each student in a class to have a OneNote section sharable among classmates, or into which the teacher can insert read-only pages. If tools facilitated such constructions they would be more common.

**The stylus**

Next we cover stylus use by teachers—in class, to ‘flip’ classes, and for marking—and student uses. Experienced educators stress the difference between a high precision, active digitizing stylus and the low-resolution, capacitive touch capability of devices such as the iPad and Surface RT, even when used with a
capacitive stick. Touch has its uses, notably in navigation, but a stylus is far more powerful when writing text or equations, highlighting, sketching, drawing, and so forth.

1. **Classroom teaching.** Some speakers use laser pointers, but adult audiences can generally identify the slide content that a speaker is emphasizing and follow along. In education, guiding students visually is crucial. K-12 teachers did not write out notes once and hand them out year after year; they wrote on a whiteboard or blackboard each time they lectured, pausing for emphasis, underlining, circling, drawing arrows—elaborating in ways not needed with adult audiences. Today, teachers with a stylus and projector can do this—and need not even turn their back on the students as they write!

2. **Flipping a class.** Traditionally much classroom time is spent listening to lectures. The simplicity of recording audio and inking while stepping through slides, and then sharing the presentation via OneNote for students to view at home, has led teachers, even those with few technical skills, to flip classrooms. As they record “screencast” presentations, teachers use a stylus to underline, circle, create arrows or annotations. This provides an intimate feel as teachers focuses on the aspects of the content that they know will guide their students. Students the watch the lecture before class, freeing class time for clarification, interaction, and individual or collaborative exercises.

3. **Marking papers.** Teachers report that cycling through students in OneNote to mark and grade homework and quizzes takes one-third as long, preserving time to interact with students (and saving trees). Teachers can instantly review a student’s work for the year to check progress, or in a parent-teacher conference. This incredible efficiency is by itself enough to motivate some schools to tackle the arduous hierarchic folder and access permissions structure for OneNote Notebook management.

4. **Student uses.** Students can write, sketch, annotate, draw, and highlight text. Computers facilitate trial-and-error learning: Erasing digital ink is much easier than erasing marks on paper. A map or figure can be traced by stylus over the tablet, with the resulting image duplicated and reused for mark-up. If space runs out, digital paper can be extended indefinitely horizontally or vertically. Like teachers who screencast to flip classes, students can create presentations or record explanations as they solve problems. An expanding library of impressive free or low-cost software can be used, such Paint.net. (Some available resources are listed on the last page.)

**OneNote as a mashable super-wiki—that provides unprecedented control and transparency.**

Students and teachers routinely save or print other documents to OneNote, including spreadsheets, Powerpoint decks, PDF and Word documents, scanned bitmaps, DyKnow files, even Google Docs output. Everything can be annotated by hand or voice, combined, and reused. Audio for foreign language exercises and video links to Khan Academy, student-produced, or other video are easily inserted. Materials distributed via email or LMS is copied into OneNote. A tablet can be a platform for educational simulation games. Collaboration and project work is natural for students familiar with sharing Notebooks and recording voice, webcam video, and ink. And hovering over all of this is the clean visibility and access where appropriate to teachers, administrators, other students, and parents.

With OneNote and the spreading use of tablet PCs in 1:1 deployments, no competitor rivals Microsoft in K12 education support. The ease of importing and exporting content to OneNote pages allows schools to use Office in close concert with other tools, such as DyKnow, Moodle, and myriad free and 3rd party apps.

The shared OneNote framework is described by some school administrators and teachers as “the holy grail of education” because it simplifies and amplifies all of their pedagogical endeavors: collaboration, personalized instruction, peer review, formative assessment, alternate forms of assessment, and showing a student’s process. OneNote becomes a fully mashable super-wiki that accepts text, ink, images, audio, video, files, or any combination, without any file structure or steep learning curve. OneNote removes constraints and lets each user employ the modality that fits the task on a digital piece of paper.

**Final motivation for next steps**

Asked what she would like to see technology provide students, a San Antonio biology teacher led with “a digital scrapbook for their high school years.” As used in some schools, OneNote delivers this. And it’s a tool
that parents learn about from their kids—use can spread from elementary school into workplaces. Circling back around, today is different because the wave of 1:1 tablet deployments will engulf schools over the next 1-3 years. If we build on our tremendous advantage the outcome could be breathtaking. If we assume OneNote is good enough for education as is and let touch pull us away from the high resolution active digitizer stylus, someone else will surely seize the initiative.

The next sections deal with what we can do. At the end are examples of student work, a list of resources available to schools, and links to videos of effective OneNote schools.

**Steps to insure that a new generation grows up with Windows and Office**

1. **Address the beginning-of-term school-wide notebook setup issue detailed below.** *(OneNote team? ISVs? Contractor?)*
2. **Promote OneNote and stylus benefits**—provide a microphone for enthusiastic schools such as Cincinnati Country Day, Whitfield, Appleby! *(See the two videos linked to at the end of this paper.)*

**OneNote Enhancements**

From the start, OneNote has been a great way to leverage tablet PCs both inside and outside classrooms, for the benefit of both educators and learners. Almost to a person, educators who are shown the capabilities of this hardware-software combination see the potential for their particular subject and teaching style—indipendent of their discipline or grade level. Almost to a person they ask, “Why haven’t I ever heard about this before?” Some ask, “Where do I get OneNote?” not realizing that it is on their tablet.

Effective use of OneNote at some schools has provided insights into pedagogically sound uses. Many are already well supported by OneNote and some would require tweaking or adding to the existing feature set. Others now require manual workarounds to get OneNote to do what is needed. If the OneNote team can address some of these as tablet prices drop, an already powerful educational tool would be irresistible.

- **The Big Ask**: Some schools discovered that with effort, Notebooks can be nested on a shared network drive. This is not supported natively by OneNote. Steps to make it work properly are finicky. For example, when a hierarchy of OneNote folders is used for a class, with a class folder writable by an instructor but not students (appearing as a Notebook to the instructor), containing subfolders writable by individual students (which appear as Section Groups to the faculty member and as a Notebook to each student), then each student must open each Notebook in OneNote before a faculty member opens it (as a Section Group). This is because OneNote’s creates a “.onetoc2” file when the folder is first opened and sets the top-most folder accessible to OneNote, which in this situation differs for faculty and students. If the faculty member opens it first, the student will not be able to access it. It is invaluable for student Notebooks to appear as Section Groups in a teacher’s “master” class Notebook, but few schools or teachers undertake the effort of setting it up. It must include restricted access privileges on student “sub-notebooks” of the teacher’s class Notebook.

The folder hierarchy might be defined in a CSV import, but a further refinement would integrate AD and/or various Learning Management Systems (Moodle, Blackboard, etc.) that automatically create class notebook structures. Teachers not using an LMS might be tied in via AD when students are on a locally shared Notebook or SharePoint server, and via email addresses if through SkyDrive.

Schools must be able to identify appropriate processes for different implementations: Windows 7 or 8, Office 365 alone or with a local server, with or without Sharepoint or Skydrive, or with mixed deployments of Office 2013 and 2010. A network drive or Skydrive is a more accessible solution for most schools so needs clear ongoing support. Confusions also around Win 8 apps: it is messy if a student with an O365 account also needs a Microsoft account; how to obtain .appx files is unclear.

- **Two natural additions**: Students occasionally switch classes, requiring the reconfiguration of the class Notebook hierarchy and permissions. Appleby wrote a Sharepoint process to automate this but not all schools can. Second, many teachers especially in earlier grades would like the option of pre-
setting Sections in student Notebooks (Homework, Notes, Quizzes, Labs, etc.), potentially with different access permissions: a Section that is read-only for the student into which a teacher can place materials, a Section shared with all students in the class. A teacher would have to specify a template from which student Notebooks would be built. Aspects of this have been scripted.

Less critical suggestions:

- The ability for teachers to distribute new pages or Sections directly to each student’s Notebook. Teachers sometimes set up entire units in advance. It is not always optimal to push out content via email, a shared Notebook, a post to an LMS, etc., for students to file. Even with older students, teachers would like to know materials reached the intended location. A non-manual process would be welcome.

  If some of this is possible without advanced scripting it should be simplified/more discoverable/ better promoted. Read-only access with dynamic control would enable sharing without risk of deletion or undesired editing. Page and Section level security control (sharing) could enable a teacher to create and share a reference Section, and could enable students collaborating on projects to each have a personal work section shared read-only with peers. Unaware of a good workaround, teachers now share information in ways open to inadvertent corruption, distribute PDF files, post the information in other ways, and even distribute paper copies leaving it to students to scan them into OneNote if they wish.

- Extending the previous point, if teachers could temporarily block sharing among students, including cutting and pasting, Notebooks could be used for open-book testing.

- Confusion exists around real-time OneNote synchronization and the overhead to make this work in a range of contexts: with or without Sharepoint, Skydrive, Lync, Office 365 alone or hybrid with a school server and Office on clients. Apparently machine-to-machine connections and Notebook sharing existed in OneNote 2003. Could SkyDrive setup and sharing be made easier? Could a class on a geology field trip with no wireless access point be able to connect devices for shared note-taking?

  OneNote offers a richer environment for shared project work, but due to ease of setup and speed of text synching some students use Google Docs for real-time collaborative work and copy the resulting content to OneNote notebooks. OneNote 2013 reportedly has faster synch in some configurations but awareness is low. Ideally ink, text and placeholders for richer media could be fast, with larger files transferred at a slower pace. Given the advantages of local copies of documents, this is desirable not only for Office 365 but for OneNote desktop/local server or hybrid uses.

- Inking. As noted above, inking is far more important than touch for education; when everyone uses tablets and OneNote, inking is more creatively used and heavily relied on. OneNote inking is much admired but the rest of Office is not. Inking is considered so inferior in PowerPoint presentation mode that some teachers print slides to OneNote and present from it, foregoing PowerPoint features. Issues also arise when viewing ink on phones or web views. Educators uniformly feel we should market the advantages of stylus with active digitizer over touch.

Feature requests:

- OneNote takes you to your most recent change in a Notebook, usually best, but a teacher’s Option to bring up the page most recently changed by the student would be useful, to go to homework or quiz and avoid e.g. intending to project to the class work that a student just did in class and accidentally instead opening the last quiz by that student the instructor graded.

- Embedding files in OneNote pages is great for creating rich project notebooks. Would like an option of substituting for the rudimentary icon e.g. a larger thumbnail picture of the first page of content.

- Printing to OneNote (especially from Office apps and web pages) could provide the option of retaining formatted text editable within OneNote (as does Copy-Paste). Word cannot be embedded in OneNote the way Excel now can? Intelligent embedding exists with Sharepoint (flagging large files for possible cloud placement) – can it be applied to notebooks stored on network drive, Skydrive?
• A discoverable way to flatten layers when ink exists over a picture so that the ink becomes part of the image content would be good. Workarounds include selecting, copying, and pasting the picture and the ink back into the page as a new picture, or setting the image as background (which few discover).
• OneNote 2013 allows a video to be imported from webcam but not a still photo, which is often desired.
• OneNote 2013 dropped Quick Access toolbar from full screen mode – desperately need it back.
• OneNote 2013 dropped option to shrink/expand Page title tabs with a click—it was used. The ability to autohide the Page list on the right to maximize space for work is needed.
• Advanced users would like VBA-style macro capability found in Word, allowing schools to create tools such as lockdown-during-tests, embedded short-answer assessment exercises. 3rd party app exists.
• Third parties investing in html5 could benefit from public MS APIs to Office 365, as well as Skype and the OneNote fat app.

Previously supported apps that teachers would like back:
• Community Clips—Office Labs add-in loved by teachers to flip classrooms, also used by students
• Mouse Mischief—Complaints that it doesn’t work with new Office releases
• MSR Interactive Classroom—some educators would even settle for the source code
• InkSeine, an MSR download that like Community Clips does not work with Win 8
• Classroom Presenter, discontinued UW-MSR tool (features being picked up by 3rd party apps)
• OneNote Calendar, a third party add-on last fully updated for 2007, provides a calendar that displays Pages on the dates last updated with preview images of selected pages, simplifying page location. Its developer reluctantly switched to Mac apps believing MS dropped Tablet PC promotion.

Conclusion: Administrators and developers at the schools mentioned are pro-OneNote, pro-tablet, and would love to discuss how OneNote, an incredible tool for education, could be made more easily deployed. They would also like to help us get the word out. Send comments and thoughts to jgrudin.

“Tablet PCs and tools like OneNote and FluidMath and DyKnow, there is literally one weakness, but it’s a big one. Obscurity. No one’s ever heard of them. I wish Microsoft was better marketers, but they’re fairly clueless.”
Sophie was a girl of many talents. She loved to paint and draw, and create pictures of strange creatures that she could not see. And then smiled back at her. All the children thought she was strange for the things she made. "Amelia can't ride bikes," they would say. But Sophie would simply snort, "Mama ran."

(created digitally by a student to illustrate her story)
Some Online Resources

Paint.net
Fresh Paint for Windows 8 or Windows RT
ArtRage  Free Demo version of 4.0, free version of 2.0 can be found
PDF Annotator  Useful app, one copy expensive but very substantial bulk discounts possible for schools
Community Clips  Simple screencasting of Powerpoint lectures, may require Windows 7
Movie Maker  Create, edit, publish videos
FluidMath  Stylus-driven math tool, free trial (licenses expensive, may be volume discount)
Project Gutenberg  ebooks
Hathi Trust 3 million digital books in the public domain
Ted talks  Over a thousand stirring lectures
Khan Academy  – and don’t forget that the MOOCs are coming!
YouTube, Wikipedia, and many other incredibly useful albeit not 100% reliable sites
DyKnow  Classroom management software

Videos showing school OneNote use
Whitfield School  (14 min.)
Rob Baker of Cincinnati Country Day School at Wiptte 2013  (49 min., worth it)